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ADDITIONAL REPORT ON FRESHWATER PLANARIANS FROM TAIWAN [1)]

by

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INTRODUCTION

After the publication of the senior author's previous papers on the freshwater planaria from Taiwan (ICHIKAWA & KAWAKATSU, 1967; KAWAKATSU & IWAKI, 1968), a number of preserved specimens collected in 1973 by Dr. Taiji IMAMURA from the Mt. Alishan district in the central part of Taiwan were sent to KAWAKATSU for study. HAGIYA, one of the co-authors of the present paper, also collected planarians from various localities in the central and the southern parts of Taiwan in 1975. On examination of these materials, the senior author has identified the species as *Dugesia japonica* ICHIKAWA et KAWAKATSU, 1964; both two subspecies (*Dugesia japonica japonica* ICHIKAWA et KAWAKATSU, 1964 and *Dugesia japonica ryukyuensis* KAWAKATSU, 1976) were included in the Dr. IMAMURA's collection. The occurrence of these two subspecies of *D. japonica* in Taiwan was noted and briefly discussed from a zoogeographical viewpoint in the paper by KAWAKATSU, OKI, TAMURA & SUGINO (1976).

As the senior author recently made a plan for the taxonomic and karyological studies on planarians from Taiwan in cooperation with the members of OKI's laboratory and LUE, a considerable number of live and preserved specimens collected by LUE from various localities were sent to the laboratories of both KAWAKATSU and OKI. Upon examination of LUE's materials, it was found out that they consist of two species, i. e., *Dugesia japonica japonica* and other non-identified *Dugesia* sp. (species of Taiwan) that has a different karyotype. The morphological and anatomical descriptions of *D. j. japonica* from various parts of Taiwan and of *D. j. ryukyuensis* from the Mt. Alishan district will be given in the present paper. The karyology of *D. j. japonica* and *Dugesia* sp. from Taiwan will also be given below, together with some ecological data observed by LUE.

LIST OF LOCALITIES

The followings are the data of the samples examined from Taiwan. The Specimen Lot Numbers given for each stock are a number registered in KAWAKATSU's fixing notebook according to his permanent recording system.

In this list the names of the localities in Taiwan are described according to the Chinese sounds (Chinese letters in parentheses).[2)] Figure 1 shows the localities in Taiwan.

1). Preliminary reports of some of this work were presented at the 49th Annual Meeting of the Zoological Society of Japan, Kumamoto, October 1978 (TAMURA, YAMAYOSHI, OKI, LUE & KAWAKATSU, 1978) and at the 50th Annual Meeting of the Zoological Society of Japan, Tôkyô, October 1979 (TAMURA, YAMAYOSHI, OKI & KAWAKATSU, 1979 b).

No. 1. Specimen Lot No. 1529 group. *Dugesia japonica japonica* (sexual and asexual specimens). A well in Matsu-tao Island located off Foochow (福建省馬祖島) in the mainland of China (alt. 25 m). Pale brown above in color with numerous dark brown pigment spots; without sensory spots at the anterior margin of the head; 8～9 mm long and 1 mm wide. April 28, 1978 (water temp., 10℃). Collected by students of K. Y. LUE. Both live and preserved specimens (fixed in Bouin's fluid) were examined cytologically and histologically.

No. 2. Specimen Lot No. 1456 group. *Dugesia japonica japonica* (sexual and asexual specimens). A stream in front of the National Palace Museum, Taipei (臺北市故宮博物院) (alt. 15 m). Pale grayish brown above in color with numerous white spots, lighter below with dark pigments; without sensory spots; 6～8 mm long and 1 mm wide. March 25, 1978 (water temp., 15℃). Coll. K. Y. LUE. Both live and preserved specimens (fixed in Bouin's fluid) were examined cytologically and histologically. Cf. LUE (1978).[3)]

No. 3. Specimen Lot No. 1476 group. *Dugesia japonica japonica* (sexual and asexual specimens). Collected from the same locality. About 15 large specimens preserved in Bouin's fluid were fully mature (13～15 mm long and 2～3.5 mm wide). February 28, 1978 (water temp., 10℃). Coll. K. Y. LUE. Both live and preserved specimens were examined cytologically and histologically.

No. 4. Specimen Lot No. 1457 group. *Dugesia* sp. (asexual specimens). Ponds of the Taipei Botanical Garden, Taipei (臺北市臺北植物園) (alt. 10 m). Pale grayish brown above in color with numerous, small white spots, lighter below with indistinct pigments; with sensory spots; 6 mm long and 1 mm wide. March 14, 1978 (water temp., 15℃). Coll. K. Y. LUE. Both live and preserved specimens (fixed in Bouin's fluid) were examined cytologically and histologically.

No. 5. Specimen Lot No. 1458 group. *Dugesia* sp. (asexual specimens). Collected from the same locality. The largest preserved specimen in Bouin's fluid attains about 8 mm long. February 26, 1978 (water temp., 15℃). Coll. K. Y. LUE. Only examined histologically.

No. 6. Specimen Lot No. 1466 group. *Dugesia* sp. (asexual specimens). Neiwho Pond in the suburban Taipei (臺北市近郊內湖) (alt. 15 m). Pale grayish brown above in color with numerous, small white spots; with sensory spots; 8～10 mm long and 1 mm wide. March 23, 1978 (water temp., 15℃). Coll. K. Y. LUE. Both live and preserved specimens (fixed in 70% ethanol) were examined cytologically and histologically.

No. 7. Specimen Lot No. 1467 group. *Dugesia* sp. (asexual specimens). Collected from the same locality. The largest preserved specimen fixed in Bouin's fluid attains 10 mm long (non-fully mature one). April 18, 1978 (water temp., 21℃). Coll. K. Y. LUE. Only examined histologically.

No. 8. Specimen Lot No. 1482 group. *Dugesia japonica japonica* (sexual and asexual speci-

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2). In the previous papers (ICHIKAWA & KAWAKATSU, 1967; KAWAKATSU & IWAKI, 1968), the names of the localities were described according to the Japanese sounds. The sexually mature animals of *Dugesia japonica* (i. e., *D. j. japonica*) were recorded from the following localities. They are:

Campus of National Taiwan University, Taipei (臺北市國立臺灣大學構內); Lüchuan, Taichung (臺中市綠川); Benbu-hsi, near Wushe, Nantou-hsien County (南投縣霧社本部溪); Mt. Cuifeng, Haualienkang-hsien County (花蓮港縣翠峯); Guanziling, near Nanshan-hsi, Chiai-hsien County (嘉義縣南山溪關子嶺); the Mt. Alishan area, Chiai-hsien County (嘉義縣阿里山地域).

Asexual specimens were also recorded from Uulai in Taipei-hsien County (臺北縣烏來), Hengye-cun and Beilao-hsi in Haualienkang-hsien County (花蓮港縣北落溪紅葉村), Nanshan-hsi in Nantou-hsien County (南投縣南山溪), and the Mt. Alishan area (阿里山地域).

3). Animals collected from this locality was used in the LUE's experiments for the determination of effects of rodenticide warfarin on freshwater organisms. Regeneration of planarians is inhibited at 25 and 50 ppm of warfarin solution. At 65 ppm, about a half of the animals died within 96 hours (LC_{50} concentration). At 120 ppm, all of the animals died within 6 hours (LUE, 1978).

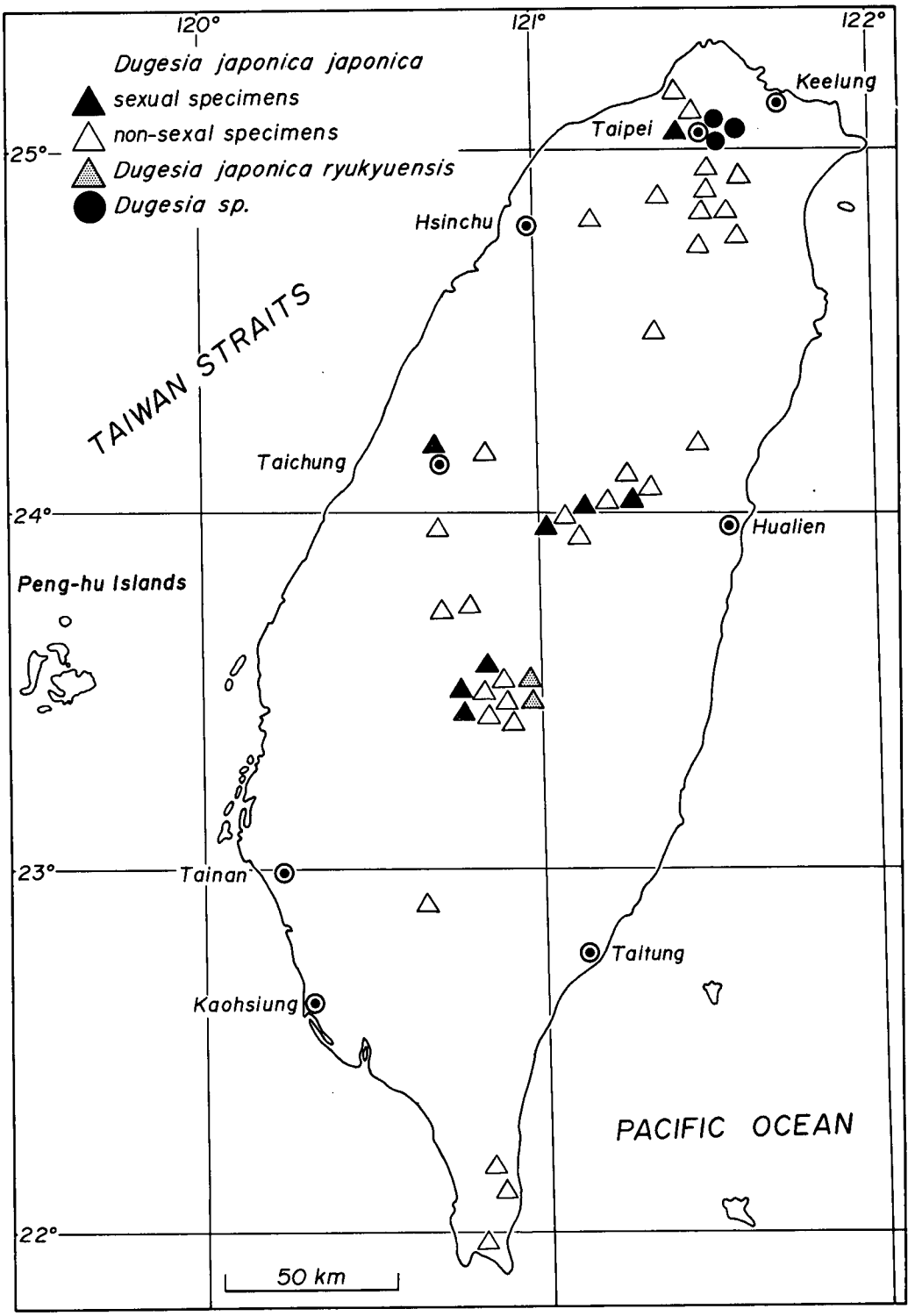

Fig. 1. Sketch map of Taiwan, showing the collecting sites of *Dugesia japonica japonica* ICHIKAWA et KAWAKATSU, *Dugesia japonica ryukyuensis* KAWAKATSU and *Dugesia* sp. (species of Taiwan) (see List of Localities).

mens). A stream at Teinmoo, Taipei (臺北市天母) (alt. 10 m). Pale brown above in color; without sensory spots; 12 mm long and 3～4 mm wide. March 31, 1978 (without data of water temp.). Coll. K. Y. LUE. Both live and preserved specimens (fixed in Bouin's fluid) were examined cytologically and histologically.

No. 9. Specimen Lot No. 1559 group. *Dugesia* sp. (asexual specimens). A newly formed swamp (Wuku Luchou swamp), Taipei-hsien County (臺北縣五股蘆洲) (alt. 2 m). A great amount of aquatic plants are grown alongside of the shore. Whitish in color; 6～8 mm long and 1 mm wide. February 24, 1979 (water temp., 19℃). Coll. K. Y. LUE. Both live and preserved specimens (fixed in 70% ethanol) were examined cytologically and histologically.

No. 10. Specimen Lot No. 1530 group. *Dugesia japonica japonica* (asexual specimens). A small stream at Yinhotung (a mountain area), Taipei-hsien County (臺北縣銀河洞) (alt. 100 m). Pale brown above in color with an indistinct white longitudinal line along the antero-posterior axis of the body; without sensory spots; 15～20 mm long and 1.5 mm wide. June 5, 1978 (water temp., 23℃). Coll. K. Y LUE. Preserved specimens (fixed in Bouin's fluid) were only examined histologically.

No. 11. Specimen Lot No. 1478 group. *Dugesia japonica japonica* (asexual specimens). A stream at Shochu-ken near Hsinten, Taipei-hasien County (臺北縣新店近郊小粗坑) (alt. 30 m). Blackish brown above in color; pale brown below; without sensory spots; 8～10 mm long and 1.5～2 mm wide. March 19, 1978 (water temp., 15℃). Coll. K. Y. LUE. Preserved specimens (fixed in 70% ethanol) were only examined histologically.

No. 12. Specimen Lot No. 1479 group. *Dugesia japonica japonica* (asexual specimens). A stream alongside a mountain road of Chihtan-tsun Village near Hsintien, Taipei-hsien County (臺北縣新店近郊直潭村) (alt. 40 m). Blackish brown above in color; pale brown below; without sensory spots; 6～8 mm long and 1.5～2 mm wide. March 19, 1978 (water temp., 15℃). Coll. K. Y. LUE. Preserved specimens (fixed in 70% ethanol) were only examined histologically.

No. 13. Specimen Lot No. 1477 group. *Dugesia japonica japonica* (asexual specimens). A small tank fed by a spring water at Uulei (also spelled Wulai), Taipei-hsien County (臺北縣烏來) (alt. 250 m). Blackish brown above in color, pale brown below with numerous grayish pigments; without sensory spots; 5～8 mm long and 1.5 mm wide. March 19, 1978 (water temp., 15℃). Coll. K. Y. LUE. Preserved specimens (fixed in 70% ethanol) were only examined histologically.

No. 14. Specimen Lot No. 1563 group. *Dugesia japonica japonica* (asexual specimens). Collected from the same locality. The largest live specimen attains about 10 mm long and slender. May 6, 1978 (water temp., 20℃). Coll. K. Y.LUE. Only examined cytologically.

No. 15. Specimen Lot No. 1480 group. *Dugesia japonica japonica* (asexual specimens). A small stream fed by a mountain spring at Tsouho near Sanshan, Taoyuan-hsien County (桃園縣三峽近郊湊合) (alt. 100 m). Brown above in color with an indistinct dark longitudinal line along the antero-posterior axis of the body; without sensory spots; 13～15 mm long and 1.5 mm wide. March 27, 1978 (without data of water temp.). Coll. K. Y. LUE. Both live and preserved specimens (fixed in Bouin's fluid) were examined cytologically and histologically.

No. 16. Specimen Lot No. 1481 group. *Dugesia japonica japonica* (asexual specimens). A stream at Minchuy on the Northern Cross Highway, near Palêngshê, Yilan-hsien County (宜蘭縣巴稜社近郊明池, 北部橫貫公路) (alt. 1150 m). Brown above in color with an indistinct dark longitudinal line along the antero-posterior axis of the body; without sensory spots; 13～15 mm long and 1.5 mm wide. April 4, 1978 (without data of water temp.). Coll. K. Y. LUE. Preserved specimens (fixed in Bouin's fluid) were only examined histologically.

No. 17. Specimen Lot No. 1464 group. *Dugesia japonica japonica* (sexual and asexual specimens). A trench at Hsinchu, Hsinchu-hsien County (新竹縣新竹) (alt. 40 m). Pale brown above in color; without sensory spots; 10 mm long and 1.5 mm wide. February 26, 1978 (water temp., 15℃). Coll. K. Y. LUE. Preserved specimens (fixed in Bouin's fluid) were only examined histologically.

No. 18. Specimen Lot No. 1465 group. *Dugesia japonica japonica* (asexual specimens). A stream at Kuanhsi, Hsinchu-hsien County (新竹縣關西) (alt. 140 m). Brown above in color; without sensory spots; 6～8 mm long and 1 mm wide. February 26, 1978 (water temp., 14℃). Coll. K. Y. LUE. Preserved specimens (fixed in Bouin's fluid) were examined only histologically.

No. 19. Specimen Lot No. 1463 group. *Dugesia japonica japonica* (asexual specimens). A stream at Kukan on the Central Cross Highway, Taichung-hsien County (臺中縣谷關, 中部橫貫公路) (alt. 750 m). Dark blackish brown above in color; pale brown below; without sensory spots; 7～8 mm long and 1 mm wide. February 5, 1978 (without data of water temp.). Coll. K. Y. LUE. Preserved specimens (fixed in Bouin's fluid) were examined only histologically.

No. 20. Specimen Lot No. 1564 group. *Dugesia japonica japonica* (asexual specimens). A stream in the Village of Chunghsing-hsintsun, Nantou-hsien County (南投縣中興新村) (alt. 90 m). Pale brown above in color; 10 mm long and 1 mm wide. March 20, 1978 (without data of water temp.). Coll. K. Y. LUE. Only examined cytologically.

No. 21. Specimen Lot No. 1343 group. *Dugesia japonica japonica* (asexual specimens). A small mountain stream at Nanshan-chi, Nantou-hsien County (南投縣南山溪) (alt. 830～850 m). Pale brown above in color with indistinct pigment spots; with sensory spots; 10～20 mm long and 1.5～3 mm wide. August 11, 1975 (water temp., 17.5～19.8℃). Coll. M. HAGIYA. Preserved specimens (fixed in Bouin's fluid) were examined only histologically.

No. 22. Specimen Lot No. 1344 group. *Dugesia japonica japonica* (sexual and asexual specimens). A mountain stream at Nêngu-ku of Nanshan-chi, Nantou-hsien County (南投縣南山溪夢谷) (alt. 770～800 m). Pale brown above in color with an indistinct white longitudinal line along the antero-posterior axis of the body; with sensory spots; 20～25 mm long and 4～5 mm wide. August 11, 1975 (water temp., 18.8～22℃). Coll. M. HAGIYA. Preserved specimens (fixed in Bouin's fluid) were examined only histologically.

No. 23. Specimen Lot No. 1345 group. *Dugesia japonica japonica* (asexual specimens). A small mountain stream at Rushian, Nantou-hsien County (南投縣盧山) (alt. 1100 m). Pale brown above in color with an indistinct white longitudinal line along the antero-posterior axis of the body; without sensory spots; 10～12 mm long and 1.5～2 mm wide. August 11, 1975 (water temp., 19.5℃). Coll. M. HAGIYA. Preserved specimens (fixed in Bouin's fluid) were examined only histologically.

No. 24. Specimen Lot No. 1340 group. *Dugesia japonica japonica* (sexual and asexual specimens). A mountain stream near the Chiaotaopin Station of the Alishan Railway, Mt. Alishan, Chiai-hsien County (嘉義縣阿里山, 阿里山登山鐵道交力坪驛) (alt. 1000 m). Pale brown above in color with an indistinct white longitudinal line along the antero-posterior axis of the body; without sensory spots; 8～15 mm long and 1～2.5 mm wide. August 9, 1975 (water temp., 18℃). Coll. M. HAGIYA. Preserved specimens (fixed in Bouin's fluid) were examined only histologically.

No. 25. Specimen Lot No. 1341 group. *Dugesia japonica japonica* (asexual specimens). A large stream near the Alishan Station Hotel, Mt. Alishan, Chiai-hsien County (嘉義縣阿里山, 阿里山賓館) (alt. 2200 m). Pale brown above in color with indistinct pigment spots; with sensory spots; 15～20 mm long and 1～2.5 mm wide. August 9, 1975 (water temp., 14.5℃). Coll. M.

HAGIYA. Preserved specimens (fixed in Bouin's fluid) were examined only histologically.

No. 26. Specimen Lot No. 1342 group. *Dugesia japonica japonica* (asexual specimens). A mountain stream near the Alishan Station Hotel, Mt. Alishan, Chiai-hsien County (嘉義縣阿里山, 阿里山賓館) (alt. 2210 m). Pale brown above in color with indistinct pigment spots; with sensory spots; 15 mm long and 1.5 mm wide. August 9, 1975 (water temp., 13.8℃). Coll. M. HAGIYA. Preserved specimens (fixed in Bouin's fluid) were examined only histologically.

No. 27. Specimen Lot No. 1374 group. *Dugesia japonica japonica* (asexual specimens). A mountain stream near the Alishan Station of the Alishan Railway, Mt. Alishan, Chiai-hsien County (嘉義縣阿里山, 阿里山登山鐵道阿里山驛) (alt. 2200 m). Pale brown above in color; with sensory spots; 12 mm long and 1.5 mm wide. November 10, 1973 (water temp., 12.5℃, pH 6.8). Coll. Dr. T. IMAMURA. Preserved specimens (fixed in 70% ethanol) were examined only histologically.

No. 28. Specimen No. 1372 group. *Dugesia japonica ryukyuensis* (sexual and asexual specimens). A small mountain stream in the forest of Mt. Alishan, Chiai-hsien County (嘉義縣阿里山, 森林) (alt. 2300 m). Dark brown above in color with numerous blackish pigments; brown below with pigments; with sensory spots; 10～15 mm long and 1～2 mm wide. November 9, 1973 (water temp., 12.0℃, pH 7.4). Coll. Dr. T. IMAMURA. Preserved specimens (fixed in 70% ethanol) were examined only histologically.

No. 29. Specimen No. 1373 group. *Dugesia japonica ryukyuensis* (sexual and asexual specimens). A small stream close by the station No. 28. Slightly paler in coloration than the previous material; 10～15 mm long and 2 mm wide. November 9, 1973 (water temp., 12.0℃). Coll. Dr. T. IMAMURA. Preserved specimens (fixed in 70% ethanol) were examined only histologically.

No. 30. Specimen Lot No. 1531 group. *Dugesia japonica japonica* (asexual specimens). A small stream of Mt. Nanjēn-shan, Pintung-hsien County (屏東縣南仁山) (alt. 600 m). Brown above in color with slightly dark pigment spots; without sensory spots; 5～8 mm long and 1 mm wide. July 13, 1978 (water temp., 22℃). Coll. K. Y. LUE. Preserved specimens (fixed in Bouin's fluid) were examined only histologically.

No. 31. Specimen Lot No. 1339 group. *Dugesia japonica japonica* (asexual specimens). A small stream near the Kentingpin-kuan Hotel, Pintung-hsien County (屏東縣墾丁賓館) (alt. 100 m). Pale brown above in color with dark pigment spots; with an indistinct white longitudinal line along the antero-posterior axis of the body; without sensory spots; 6～10 mm long and 1～2 mm wide. August 6, 1975 (water temp., 24℃). Coll. M. HAGIYA. Preserved specimens (fixed in Bouin's fluid) were examined only histologically.

After this list was arranged, additional specimens from several localities were received from LUE. They are:

No. 32. Specimen Lot No. 1562 group. *Dugesia japonica japonica?* (asexual specimens). A stream in the vicinity of Tanshui, Taipei-hsien County (臺北縣淡水) (alt. 35 m). Whitish in color after fixed in 70% ethanol; 6～8 mm long and 1～1.5 mm wide. March 25, 1979 (water temp., 14～16.5℃, pH 6.0～6.5). Coll. K. Y. LUE. Preserved specimens were examined only histologically.

No. 33. Specimen Lot No. 1561 group. *Dugesia japonica japonica* (asexual specimens). A mountain stream in the forest of Hsitou, Luku-hsiang, Nantou County (南投縣鹿谷鄉溪頭森林) (alt. 1100 m). Pale brown above in color; 6～8 mm long and 1.5 mm wide. March 6, 1979 (without data of water temp.). Coll. Mr. K. S. WU. Preserved specimens (fixed in Bouin's fluid) were examined only histologically.

No. 34. Specimen Lot No. 1560 group. *Dugesia japonica japonica* (asexual specimens).

A stream at Sanping, Kaohsiung-hsien County (高雄縣扇平) (alt. 750 m). Whitish in color after fixed in 70% ethanol; 8～10 mm long and 1 mm wide. January 1, 1979 (water temp., 15℃). Coll. K. Y. LUE. Preserved specimens were examined only histologically.

During the past two years, LUE and his students collected asexual specimens that seem to be *Dugesia japonica japonica* from several localities in Taiwan. These records are:

Daping in Matsu-tao Island (馬祖島大坪; alt. 30 m, Dec. 25, 1978); Shuangchi-pupu Waterfall, Taipei (臺北市雙溪瀑布); Shihdean, Taipei-hsien County (臺北縣石碇; alt. 200 m, Feb. 10, 1979); Palēngshē, Yilan-hsien County (宜蘭県巴稜社); Wuling, Taichung-hsien County (臺中縣武稜); Changchunci, near Tienshang, Hualienkang-hsien County (花蓮港県天祥近郊長春祠); Hsitou, near Hsinhsi, Nantou-hsien County (南投縣信義近郊溪頭); Sanping, Kaohsiung-hsien County (高雄縣扇平; alt. 750 m, water temp., 12℃, pH 7.3, July 5, 1979); Suchung-hsi Hot Spring, Pintung-hsien County (屏東縣四重溪温泉).

PRESENTATION OF RESULTS

Order TRICLADIDA

Suborder PALUDICOLA or PROBURSALIA

Family Dugesiidae

Genus *Dugesia* GIRARD, 1850

Dugesia japonica ICHIKAWA et KAWAKATSU, 1964

Dugesia japonica japonica ICHIKAWA et KAWAKATSU, 1964

External characters. The general appearance of the preserved specimens from 7 localities of Taiwan is shown in the photographs in Figure 2 (A-J). The color of the body varies according to the difference of the populations (see List of Localities). The body of animals from many localities is a uniform pale brown to grayish brown on the dorsal side with numerous blackish brown pigments. Animals from several localities show a dark brown to blackish brown coloration. Animals with small, white pigment spots or an indistinct longitudinal line along the antero-posterior axis of the body were also observed. Usually, the ventral side is paler in coloration than the dorsal but sometimes it has pigments.

The indistinct sensory spots (usually 10 in number) arranged at the anterior margin of the body are found in the specimens from several localities. There are no morphological peculialities concerning the positions of eyes, sensory organs, a mouth and a genital pore.

Internal characters. In the animals identified as *D. j. japonica* from Taiwan are included both sexual and asexual specimens, and the external musculature of the pharynx consists of two layers, i. e., an outer longitudinal and an inner circular muscle fiber.

Figure 3 (A-D) shows a sagittal view of the copulatory apparatus of 4 specimens from the localities of Taipei (A), Shincheu (B), Nanshan-chi (C), and Mt. Alishan (D). Photomicrographs of their copulatory apparatus are also shown in Figure 4 (A-N).

Since the genital anatomy of *D. j. japonica* from 5 localities (Taipei, Lüchuan in Taichung, Wushe, Guanziling, and Mt. Alishan) was described in the previous paper (cf. KAWAKATSU & IWAKI, 1968), only a description of the main characters of a copulatory apparatus of the animals from the other 4 localities is given here. The penis bulb is very large in size and contains a wide bulbar cavity with an irregular outline. The asymmetrical penis papilla is large in size and highly

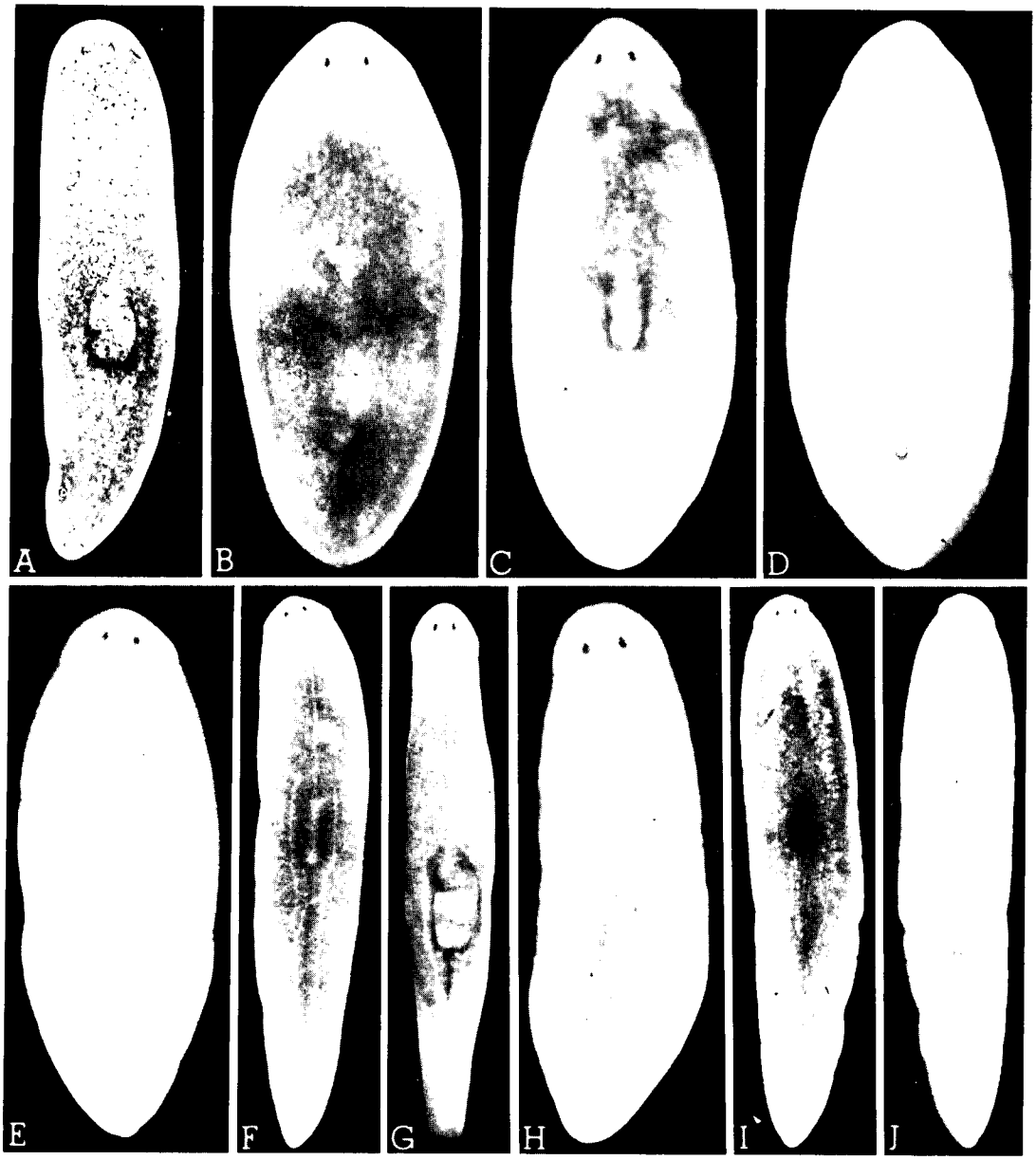

Fig. 2. *Dugesia japonica japonica* ICHIKAWA et KAWAKATSU. All the preserved specimens. A : Sexually immature specimen from Matsu-tao Island (Specimen Lot No. 1529 group). B : Sexually mature specimen from the National Palace Museum locality in Taipei (Specimen Lot No. 1476 group). C-E : Sexually mature specimens from the Teinmoo locality in Taipei (Specimen Lot No. 1482 group ; E, ventral view of the specimen C). F: Sexually immature specimen from the Yinhotung locality in Taipei-hsien County (Specimen Lot No. 1530 group). G : Sexually immature specimen from the Minchuy locality in Yilan-hsien County (Specimen Lot No. 1481 group). H : Asexual specimen from the Hsinchu locality in Hsinchu-hsien County (Specimen Lot No. 1464 group). I and J : Sexually mature specimen from the Nêngu-ku in Nantou-hsien County (Specimen Lot No. 1344 group ; J, ventral view of the specimen I).

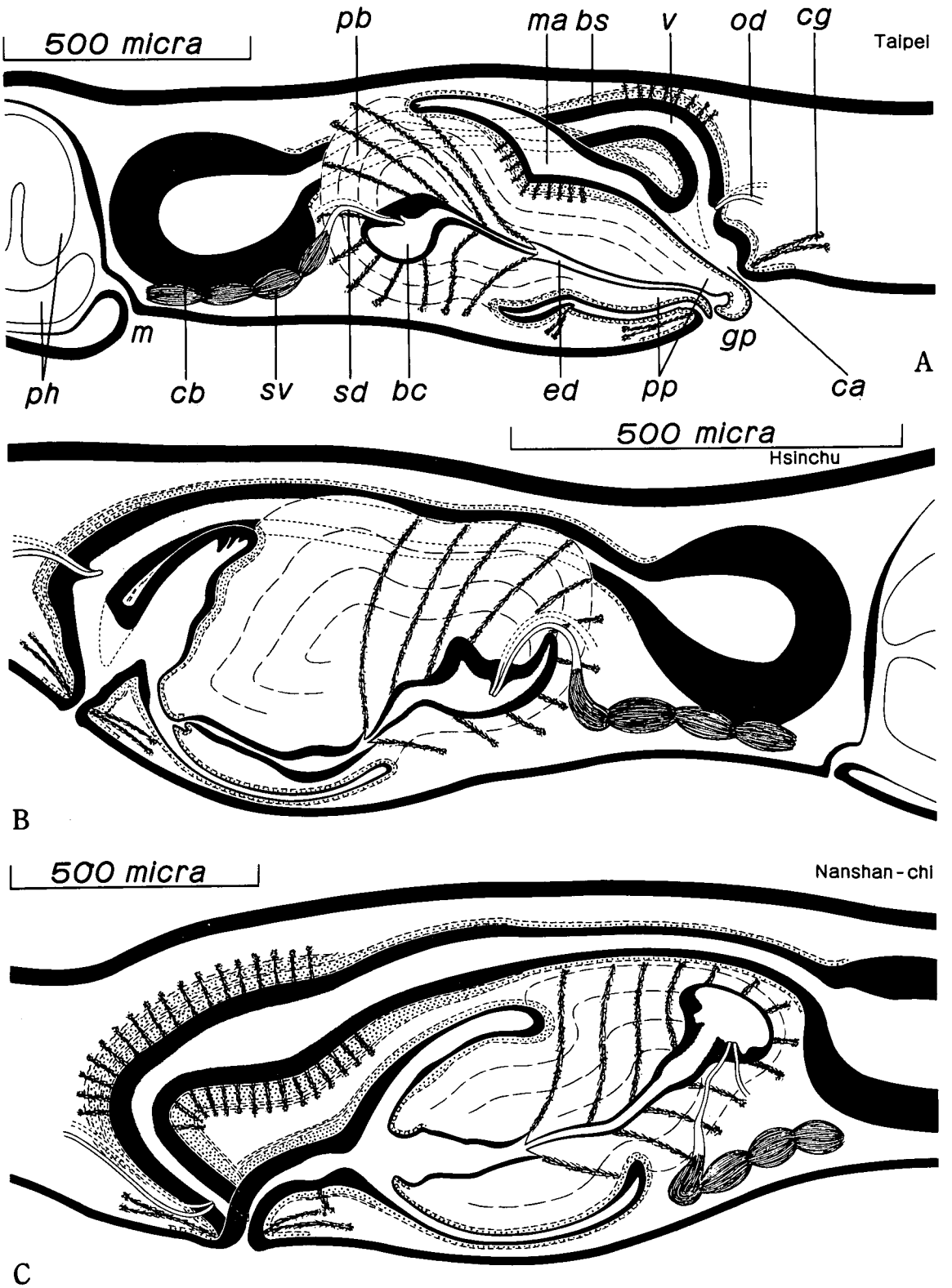

Fig. 3. Explanation on page 68.

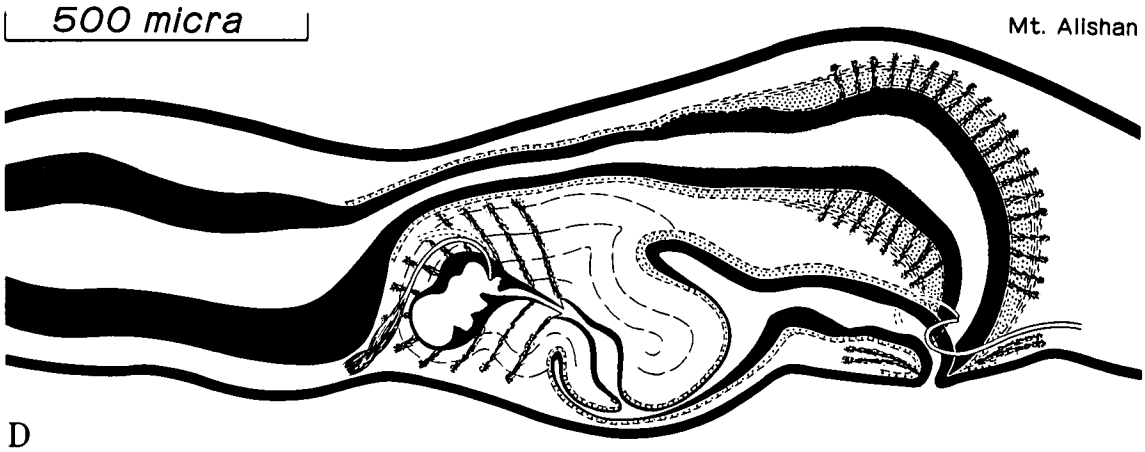

Fig. 3. Diagrams showing the sagittal view of the copulatory apparatus of *Dugesia japonica japonica* ICHIKAWA et KAWAKATSU from 4 localities in Taiwan.
A : Specimen Lot No. 1476-a from the National Palace Museum locality in Taipei. B : Specimen Lot No. 1464-a from the Hsinchu locality in Hsinchu-hsien County. C: Specimen Lot No. 1344-a from the Nêngu-ku locality in Nantou-hsien County. D : Specimen Lot No. 1340-b from the Mt. Alishan locality (Chiaotaopin Station) in Chiai-hsien County.
bc, bulbar cavity ; **bs,** bursa stalk ; **ca,** common antrum ; **cb,** copulatory bursa ; **cg,** cement gland ; **ed,** ejaculatory duct ; **gp,** genital pore ; **m,** mouth ; **ma,** male antrum ; **od,** ovovitelline duct ; **pb,** penis bulb ; **ph,** pharynx ; **pp,** penis papilla ; **sd,** sperm duct ; **sv,** spermiducal vesicle ; **v,** vagina.

muscular in nature. A diaphragm in the penis lumen is conspicuous. The epithelium covers the papilla is an insunk nuclei type. The epitherial musculature consisting of the circular and the thin longitudinal fibers is much thicker in the dorsal lip than that in the ventral one. Usually, the male genital antrum is lined by a glandular epithelium of an insunk type. However, in the specimens from the Taipei locality (Specimen Lot No. 1476 group), the epithelium of the basal parts of both the papilla and the male antrum has nuclei.

Fig. 4. Photomicrographs showing the parts of the copulatory apparatus of *Dugesia japonica japonica* ICHIKAWA et KAWAKATSU from Taiwan. A-F : Six specimens from the National Palace Museum locality in Taipei (Specimen Lot No. 1476 group). A, No. 1476-a ; B, No. 1476-b ; C, No. 1476-c ; D, No. 1476-f ; E and F, No. 1476-g ; G, No. 1476-l. H-J : Three specimens from the Teinmoo locality in Taipei (Specimen Lot No. 1482 group). H, No. 1482-a ; I, No. 1482-b ; J, No. 1482-d. K : Specimen from the Hsinchu locality in Hsinchu-hsien County (Specimen Lot No. 1464-a). L : Specimen from the Mt. Alishan locality (Chiaotaopin Station) in Chiai-hsien County (Specimen Lot No. 1340-b). M and N : Specimen from the Nêngu-ku locality in Nantou-hsien County (Specimen Lot No. 1344-a). M, posterior part of the copulatory apparatus ; N, anterior part of the copulatory apparatus.
bc, bulbar cavity ; **bs,** bursa stalk ; **buc,** bursal canal ; **cb,** copulatory bursa ; **ed,** ejaculatory duct ; **ma,** male antrum ; **od,** ovovitelline duct ; **pb,** penis bulb ; **pp,** penis papilla ; **sd,** sperm duct.

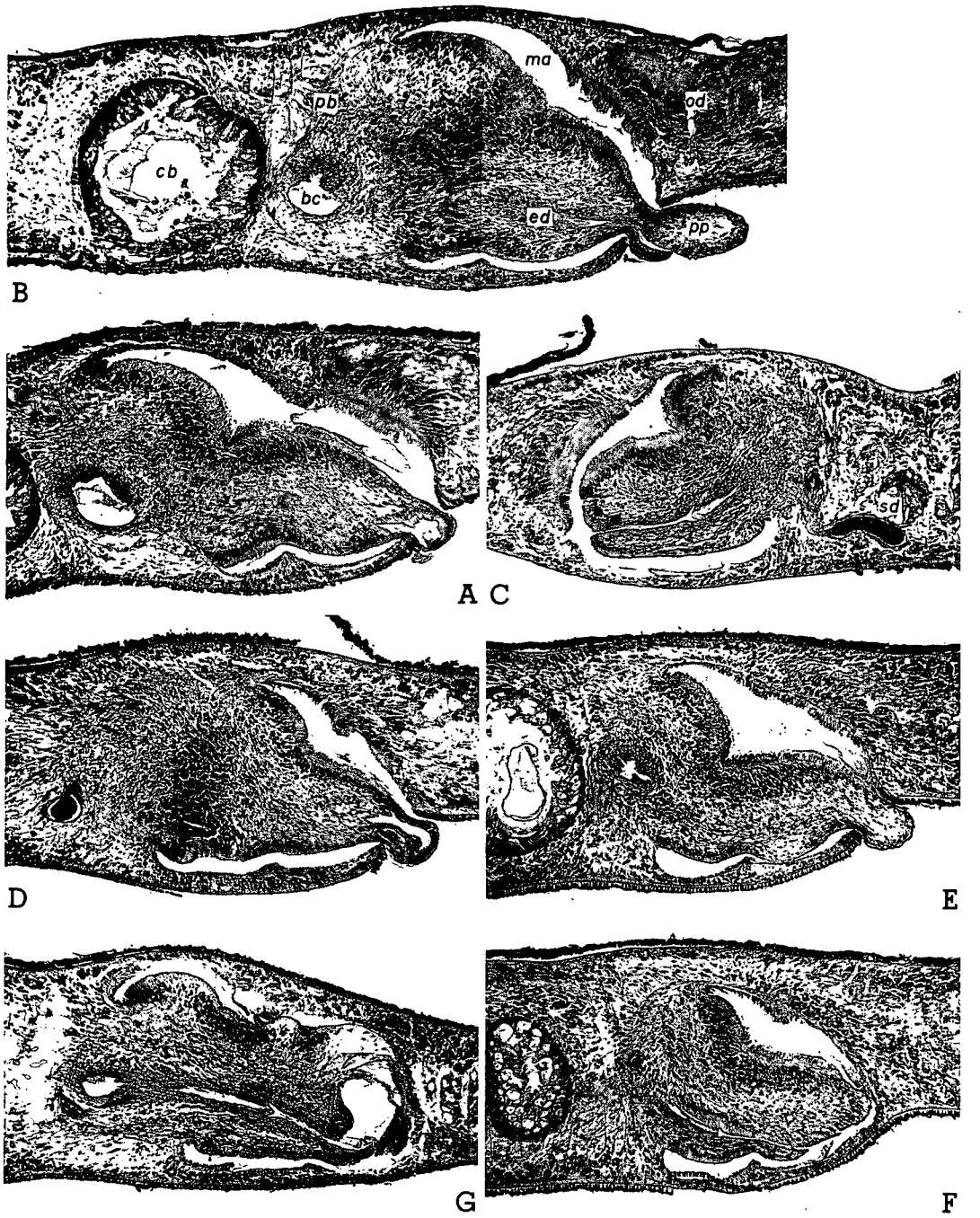

Fig. 4. Explanation on page 68.

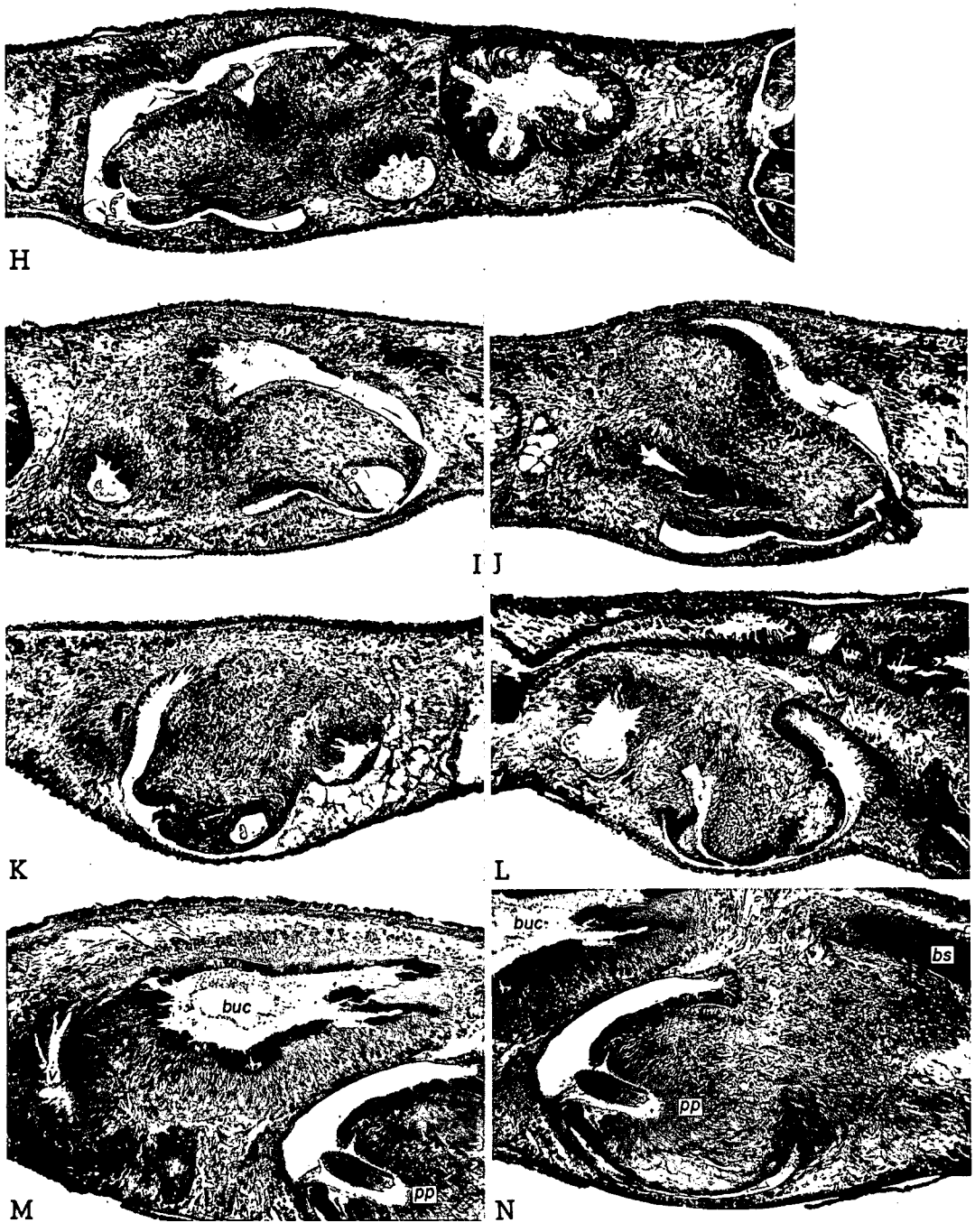

Fig. 4. Explanation on page 68.

The copulatory bursa is moderate (the Taipei and the Hsinchu specimens) to large (the Nanshan-chi and the Mt. Alishan specimens) in size. The bursa stalk has a glandular, nucleate epithelium. The anterior section of the stalk has a muscular coat consisting of two layers of fibers, a thick inner layer of circular and a thin outer layer of longitudinal. In the posterior section of the stalk, its surrounding muscular coat becomes much thicker than that in the anterior section and the inner thin longitudinal muscle fibers are added. In the region of a vagina, the muscular coat consists of thin longitudinal muscle fibers and intermingled longitudinal and circular ones. The vagina is moderately developed in the specimens from the Taipei and the Hsinchu localities; it is well-developed in the specimens from the Nanshan-chi and the Mt. Alishan localities.

Material. About 20 sets of serial sections of the sexually mature specimens (Specimen Lot Nos. 1476, 1464, 1344, and 1340 groups), several whole mounts and preserved specimens in alcohol are retained in KAWAKATSU's laboratory of Fuji Women's College in Sapporo, Japan. Some of these sections will be deposited in the Department of Zoology, National Science Museum, Tôkyô, Japan, and in the Department of Biology, National Taiwan Normal University, Taipei, Taiwan.

Cytological observation. The animals from the 6 localities (Matsu-tao Island, National Palace Museum in Taipei, Teinmoo in Taipei, Uulei in Taipei-hsien County, Tsouho near Sanshan in Taoyuan-hasien County, and Chunghsing-hsintsun in Nantou-hsien County) were examined cytologically (cf. Table 1). Their karyotypes were reported in a preliminary form by TAMURA, YAMAYOSHI, OKI, LUE & KAWAKATSU (1978)

No. 1. Specimens from Matsu-tao Island. One sexual and 2 asexual specimens were examined. The diploid karyotype is typical of *Dugesia japonica japonica* (2x = 16). Namely, it consists of 8 pairs of meta- or submetacentric chromosomes in descending order of size (Figs. 5A and 6-1). Although sperms were found in the slides of the sexual specimen, any of the figures of meiosis could not be observed.

No. 2. Specimens from the National Palace Museum in Taipei. Seven sexual specimens (2 from the Specimen Lot No. 1456 group and 5 from the Specimen Lot No. 1476 group) were

Table 1. Karyotypes of *Dugesia japonica japonica* from 6 localities in Taiwan.

Name of the stocks (localities)	No. of the specimens examined cytologically			Chromosome nos., karyotypes & the no. of cells studied in parentheses	
	Total	Sexual specimens	Asexual specimens	Male line (meiosis)	Somatic line (mitosis)
No. 1 Matsu-tao Island	3	1	-	-	2x = 16 (35)
		-	2	-	2x = 16 (65)
No. 2 National Palace Museum in Taipei	7	7	-	n = 8 (18)	2x = 16 (397)
No. 8 Teinmoo in Taipei	6	6	-	n = 8 (29)	2x = 16 (192)
No. 14 Uulei in Taipei-hsien County	3	-	3	-	(3x-1) + 2LB = 25 (151)
No. 15 Tsouho near Sanshan in Taoyuan-hsien County	5	-	4	-	(3x-1) + 2LB = 25 (120)
			1	-	(3x-1) + 1LB = 24 (30) &
					(3x-1) + 2LB = 25 (23)
No. 20 Chunghsing-hsintsun in Nantou-hsien County	4	-	4	-	(3x-1) + 1LB = 24 (103)

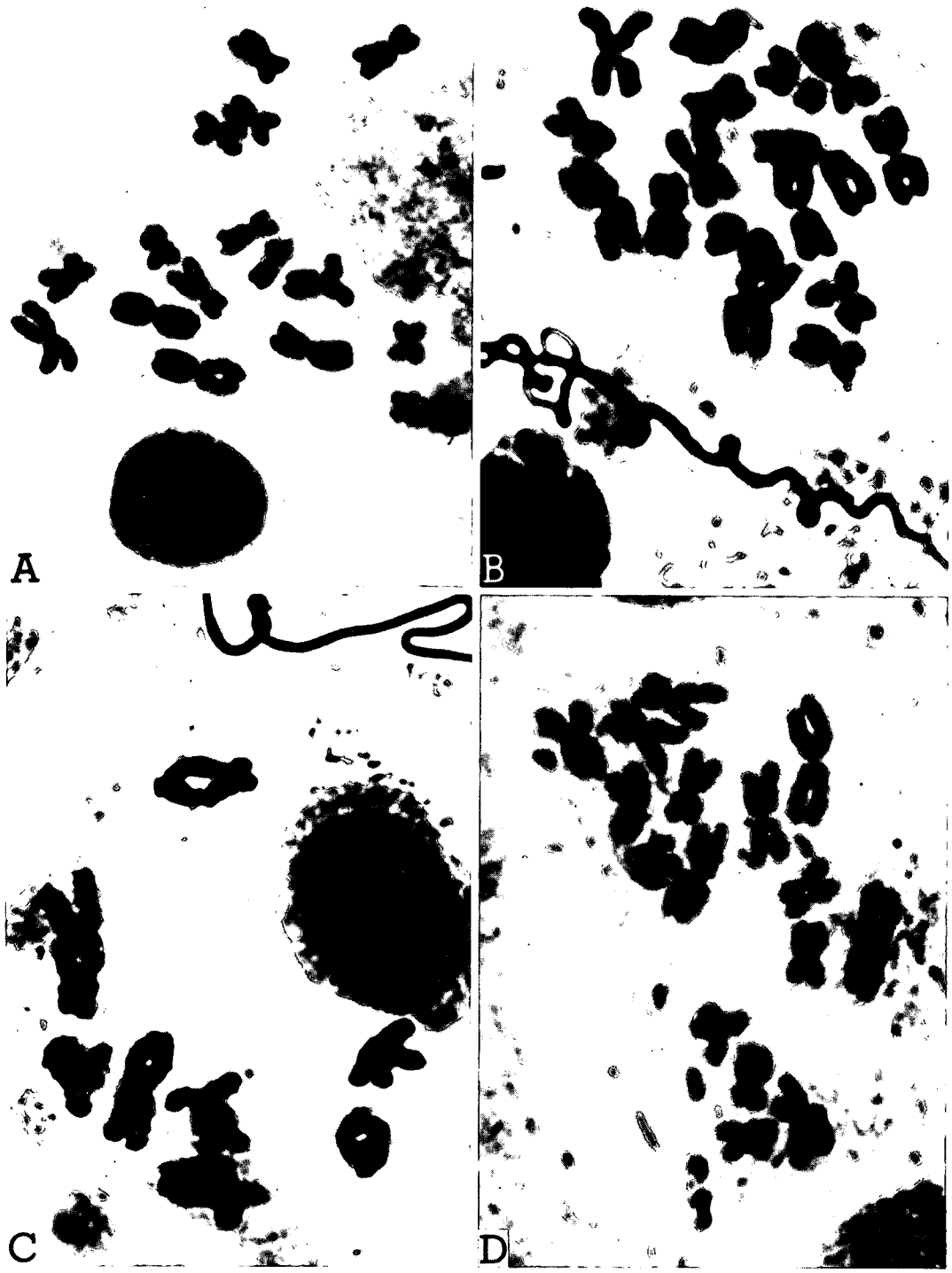

Fig. 5. Explanation on page 74.

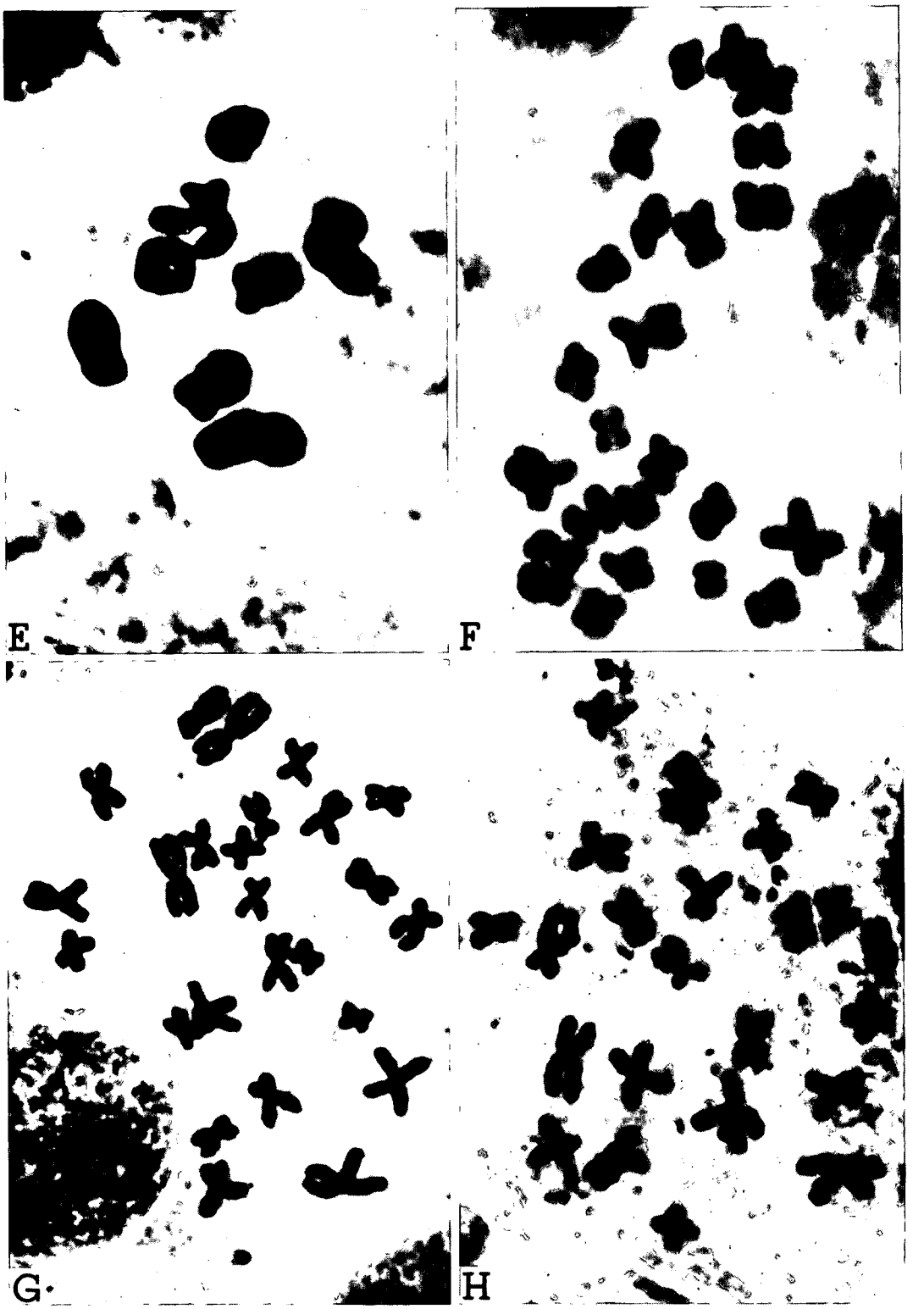

Fig. 5. Explanation on page 74.

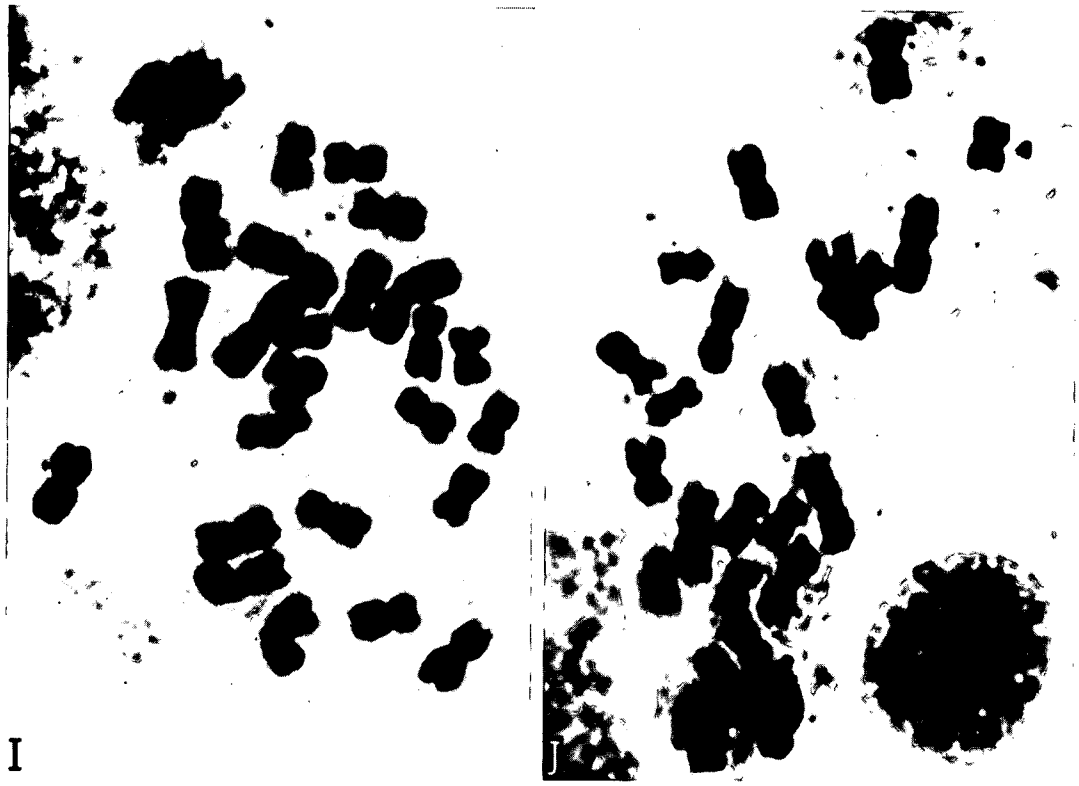

Fig. 5. Photomicrographs of the chromosomes of *Dugesia japonica japonica* ICHIKAWA et KAWAKATSU from 6 localities in Taiwan. A : Matsu-tao Island stock. 2x = 16. B : National Palace Museum stock in Taipei. 2x = 16. Notice sperms. C : National Palace Museum stock. n = 8. Notice sperms. D : Teinmoo stock in Taipei. 2x = 16. E : Teinmoo stock. n = 8. F : Uulei stock in Taipei-hsien County. $(3x-1)+2=25$. G : Tsouho stock near Sanshan in Taoyuan-hsien County. $(3x-1)+2=25$. H : Tsouho stock. $(3x-1)+1=24$. I : Tsouho stock. $(3x-1)+2=25$. H and I were found in one body. J : Chunghsing-hsintsun stock in Nantou-hsien County. $(3x-1)+1=24$.

examined. The diploid karyotype is typical of *D. j. japonica* (2x = 16) (Figs. 5B and 6-2). Sperms were found in every specimen examined. In 2 specimens, 18 figures of 8 bivalents of the haploid set in a diakinesis stage of the male germ line were observed (Fig. 5C).

No. 8. Specimens from Teinmoo in Taipei. Six sexual specimens were examined. The diploid karyotype is typical of *D. j. japonica* (2x = 16) (Figs. 5D and 6-8). Sperms were found in 2 specimens only. Twenty-nine figures of 8 bivalents of the haploid set in a diakinesis stage of the male germ line were observed in one specimen (Fig. 5E).

No. 14. Specimens from Uulei (Wulai) in Taipei-hsien County. Three asexual specimens were examined. No diploid specimen was found in this population. One hundred and fifty-one mitoses revealed a chromosome number of 25 $[(3x-1)+2LB=25]$ (Figs. 5F and 6-14). As will be found in the idiogram of Figure 6-14, this heteroploid karyotype of *D. j. japonica* may be explained by the elimination of one chromosome of the labelled 2 eutriploid set of chromosomes and the addition of 2 large metacentric supernumerary chromosomes.

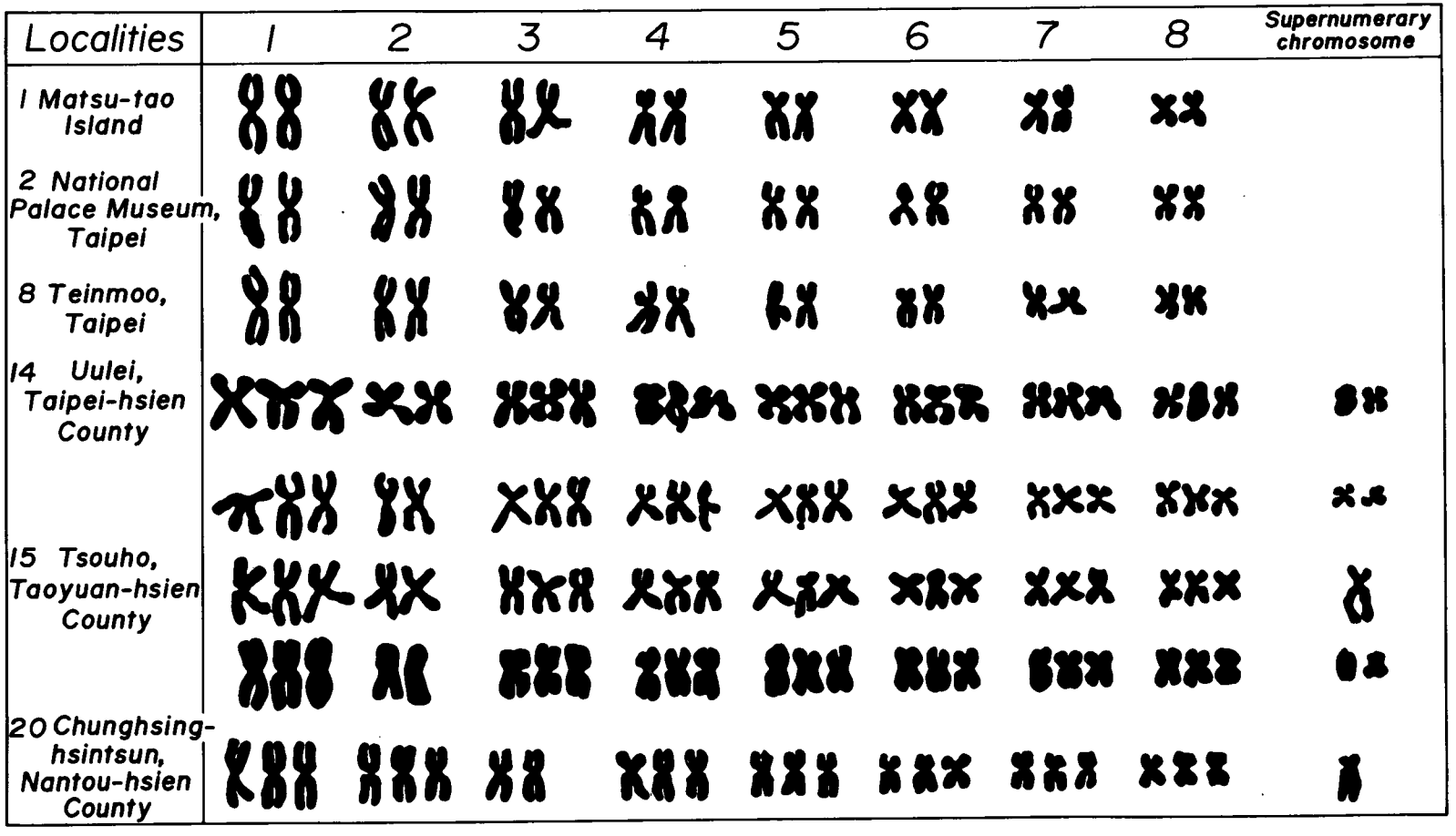

Fig. 6. Idiograms of *Dugesia japonica japonica* ICHIKAWA et KAWAKATSU from 6 localities in Taiwan. 1: Matsu-tao Island stock. $2x = 16$. 2: National Palace Museum stock in Taipei. $2x = 16$. 8: Teinmoo stock in Taipei. $2x = 16$. 14: Uulei stock in Taipei-hsien County. $(3x-1)+2=25$. 15: Tsouho stock near Sanshan in Taoyuan-hsien County. Top, $(3x-1)+2=25$; Middle, $(3x-1)+1=24$; Bottom, $(3x-1)+2=25$. Middle and bottom were found in one body. 20: Chunghsing-hsintsun stock in Nantou-hsien County. $(3x-1)+1=24$.

The heteroploid karyotype described above is similar to that of *D. j. japonica* from the populations of the Ôita-Kujû stock and the Chikushino-Ôishi stock in Kyûshû in Japan (cf. TAMURA, YAMAYOSHI, OKI & KAWAKATSU, 1978, In press). In the animals of the Japanese populations, however, a few additional small supernumerary chromosomes were found.

No. 15. Specimens from Tsouho near Sanshan in Taoyuan-hsien County. Five asexual specimens were examined. Four of them were the heteroploid specimens having cells with chromosome number of 25 [(3x−1)+2LB=25] (Figs. 5 G and 6-15, top). In the remaining specimen, the occurrence of two different types of cells intermingled in one body was observed (i. e., the mixoploid type). The first type of cells (30 in number) had 24 chromosomes [(3x−1)+1LB=24] (Figs. 5 H and 6-15, middle). The second type of cells (23 in number) had 25 chromosomes [(3x−1) + 2LB = 25] (Figs. 5 I and 6-15, bottom). In the former, one chromosome of the labelled 2 eutriploid set of chromosomes may be omitted with one rather large subtelo- or submetacentric supernumerary chromosome added (Fig. 6-15, middle).

No. 20. Specimens from Chunghsing-hsintsun in Nantou-hsien County. Four asexual specimens were examined. One hundred and three mitoses revealed a chromosome number of 24 [(3x−1)+1LB=24] (Figs. 5J and 6-20). This heteroploid karyotype is very similar to that of the cells of the specimen from Tsouho population described in the foregoing section. The idiogram of the Chunghsing-hsintsun animals was explaind by the elimination of one chromosome of the labelled 3 eutriploid set of chromosomes and added one large subtelo- or submetacentric supernumerary chromosome (Fig. 6-20).

Dugesia japonica ryukyuensis KAWAKATSU, 1976

External characters. The general appearance of the preserved specimens from the Mt. Alishan localities is shown in the photographs in Figure 7 (A-C). The body of the sexual specimens is a uniform brown to dark brown on the dorsal side with numerous blackish pigments. The ventral side is a blackish color. The sensory spots (10 in number) are conspicuous at the anterior margin of a body.

Internal characters. The external musculature of the pharynx consists of an outer longitudinal and an inner circular muscle fiber.

A sagittal view of the copulatory apparatus of one specimen is shown in Figure 8. Figure 9 (A-D) shows the photomicrographs of the copulatory apparatus.

The penis bulb is very large in size and contains a wide bulbar cavity. The penis papilla that has a strong constriction or the valve at its basal part is moderately long, conical and asymmetrical in shape. A diaphragm in the penis lumen is conspicuous. The ejaculatory duct is rather wide in most of the specimens examined. The dorsal lip of the valve is smaller than the ventral one. The valves (especially the ventral one) contain numerous eosinophilic glands. The outer wall of the papilla is lined with a nucleate epithelium. The male genital antrum is lined by a glandular, nucleate epithelium.

The copulatory bursa is moderately large in size. The bursal canal has a glandular, nucleate epithelium. The anterior two-thirds of the bursa stalk has a muscular coat consisting of an inner circular and an outer thin longitudinal fiber. The posterior one-third of the stalk becomes thick and wide to from the moderately developed vagina. The subepitherial muscle fibers consist of three

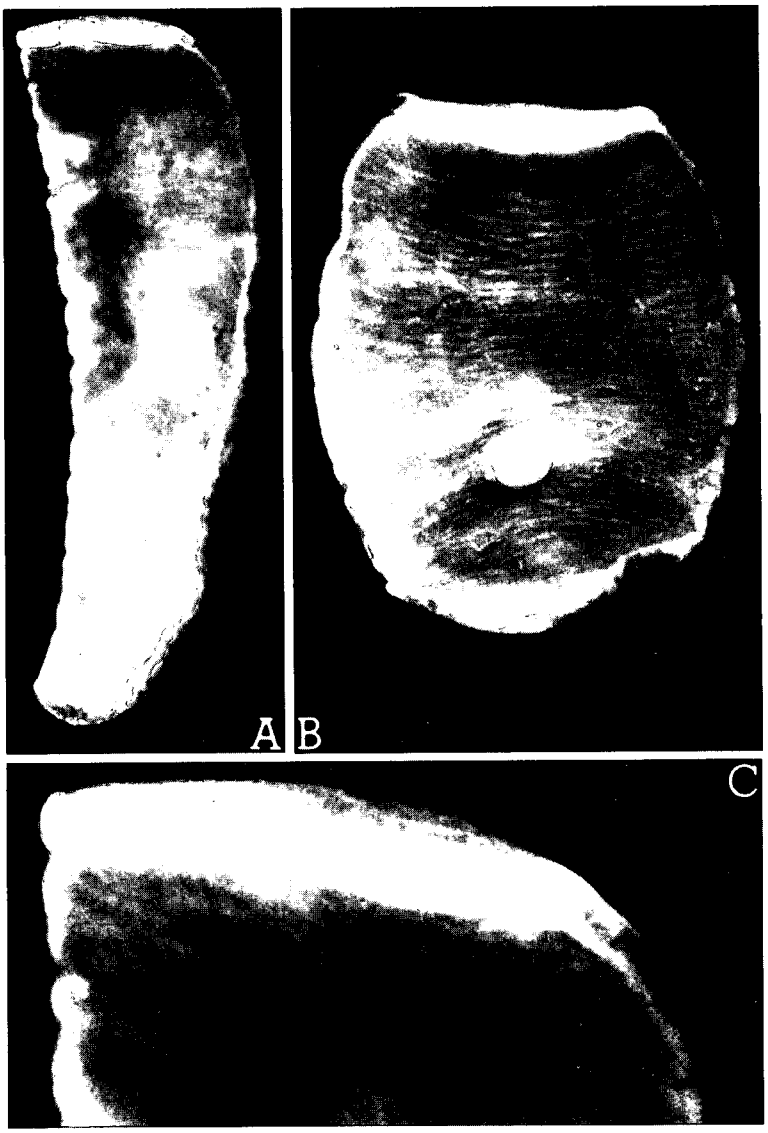

Fig. 7. *Dugesia japonica ryukyuensis* KAWAKATSU. All the preserved specimens. A-C : Two sexually mature specimens from the Mt. Alishan locality in Chiaihsien County (Specimen Lot No. 1372 group). C, enlarged photograph showing the sensory spots of the specimen A.

layers, i. e., an inner thin longitudinal, a middle thick circular, and an outer longitudinal (the second and the third muscle layers are slightly intermingled with each other).

Material. Three sets of the serial sections of the sexually mature specimens (Specimen Lot Nos. 1372 and 1373 groups) are retained in KAWAKATSU's laboratory of Fuji Women's College in Sapporo, Japan. The Specimen No. 1373 f (sagittal sections) will also be deposited in the Department of Zoology, National Science Museum, Tôkyô, Japan.

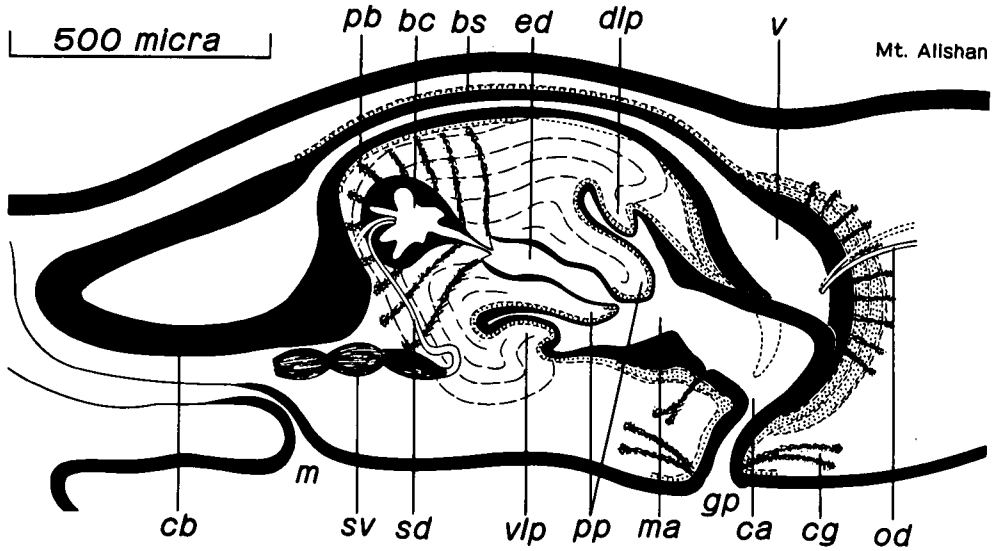

Fig. 8. Diagram showing the sagittal view of the copulatory apparatus of *Dugesia japonica ryukyuensis* KAWAKATSU from the Mt. Alishan locality in Chiai-hsien County (Specimen Lot No. 1373-f).

bc, bulbar cavity ; **bs,** bursa stalk ; **ca,** common antrum ; **cb,** copulatory bursa ; **cg,** cement gland ; **dlp,** dorsal lip of the penis papilla ; **ed,** ejaculatory duct ; **gp,** genital pore ; **m,** mouth ; **ma,** male antrum ; **od,** ovovitelline duct ; **pb,** penis bulb ; **ph,** pharynx ; **pp,** penis papilla ; **sd,** sperm duct ; **sv,** spermiducal vesicle ; **v,** vagina ; **vlp,** ventral lip of the penis papilla.

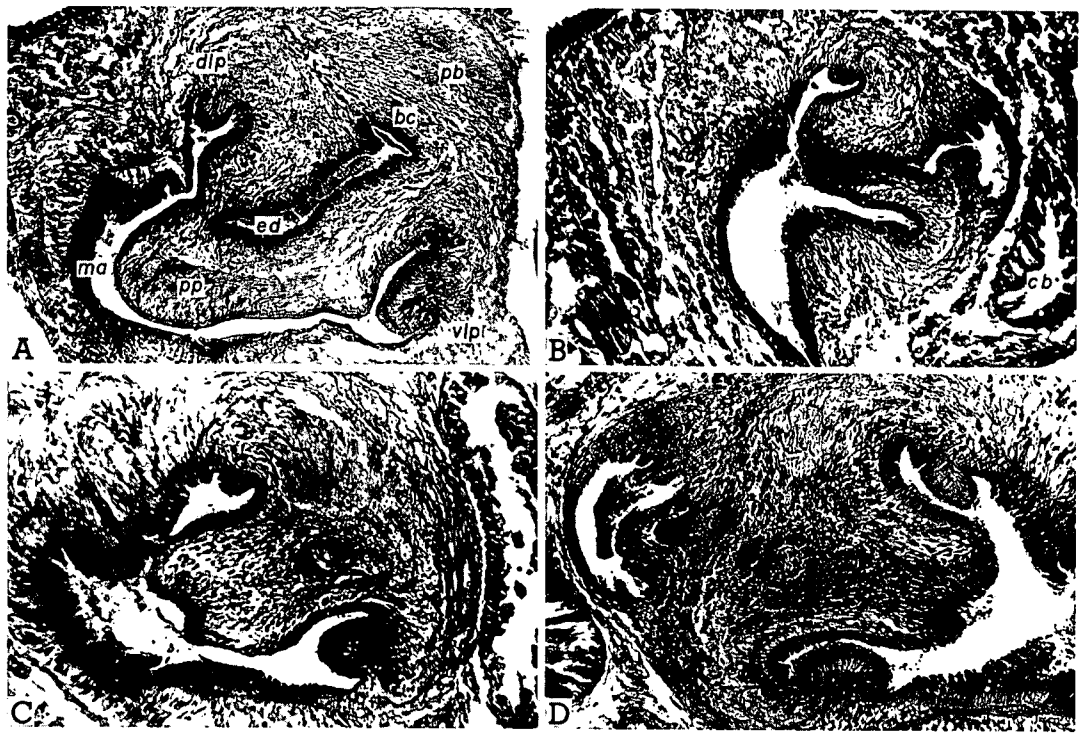

Fig. 9. Explanation on page 79.

Dugesia sp. (species of Taiwan)

Only sexually immature specimens from the three localities in Taipei (a pond of the Taipei Botanical Garden, Neiwho Pond and Wuku Luchou swamps) were available for study.

External characters. The appearance of both the live and preserved specimens is shown in photographs in Figure 10 (A-D). The largest live specimen attains 8 mm in body length and 1 mm width. The head has a subtriangular form with short, bluntly pointed auricles. The posterior end of a body is bluntly pointed. In the preserved condition, the auricles are inconspicuously present.

The ground color of the dorsal side is a pale grayish brown to dark brown with numerous dark pigments or small granules. Many pale yellowish white spots are noticiable. The ventral side is a pale brown with numerous indistinct pigments. The eyes, each surrounded by a pigment-free ocular area, are situated on the usual dorsal position of the head; the distance between them attains to about one-third the width of the head at the level of eyes. The auricular sensory organ is of a curved linear-oblanceolate shape. Indistinct sensory spots (8 to 10 in number) are visible along the anterior margin of a body.

The short pharynx is inserted at about the middle of a body. The internal muscle zone of the pharynx shows the typical arrangement of the genus *Dugesia*. The external muscle zone consists of an outer longitudinal fiber and an inner circular one.

Material. Several sets of serial sections of the sexually immature specimens (Specimen Lot Nos. 1457 and 1467 groups), several whole mounts and preserved specimens in alcohol (Specimen Lot Nos. 1458 and 1466 groups) are retained in KAWAKATSU's laboratory of Fuji Women's College in Sapporo, Japan.

Table 2. Karyotypes of *Dugesia* sp (species of Taiwan) from 3 localities in Taiwan.

Name of the stocks (localities)	No. of the specimens examined cytologically			Chromosome nos., karyotypes & the no. of cells studied in parentheses	
	Total	Sexual specimens	Asexual specimens	Male line (meiosis)	Somatic line (mitosis)
No. 4 Taipei Botanical Garden	5	-	5	-	2x = 16 (243)
No. 6 Neiwho Pond in Taipei	5	-	5	-	2x = 16 (137)
No. 9 Wuku Luchou swamp in Taipei-hsien County	7	-	7	-	2x = 16 (191)

Fig. 9. Photomicrographs showing the parts of the copulatory apparatus of *Dugesia japonica ryukyuensis* KAWAKATSU from Taiwan. A-C: Three specimens from the Mt. Alishan locality in Chiai-hsien County (Specimen Lot No. 1372 group) A, No. 1372-c; B. No. 1372-g; C, No. 1372-h. D: Specimen Lot No. 1373-f.
bc, bulbar cavity; **cb,** copulatory bursa; **dlp,** dorsal lip of the penis papilla; **ed,** ejaculatory duct; **ma,** male antrum; **pb,** penis bulb; **pp,** penis papilla; **vlp,** ventral lip of the penis papilla.

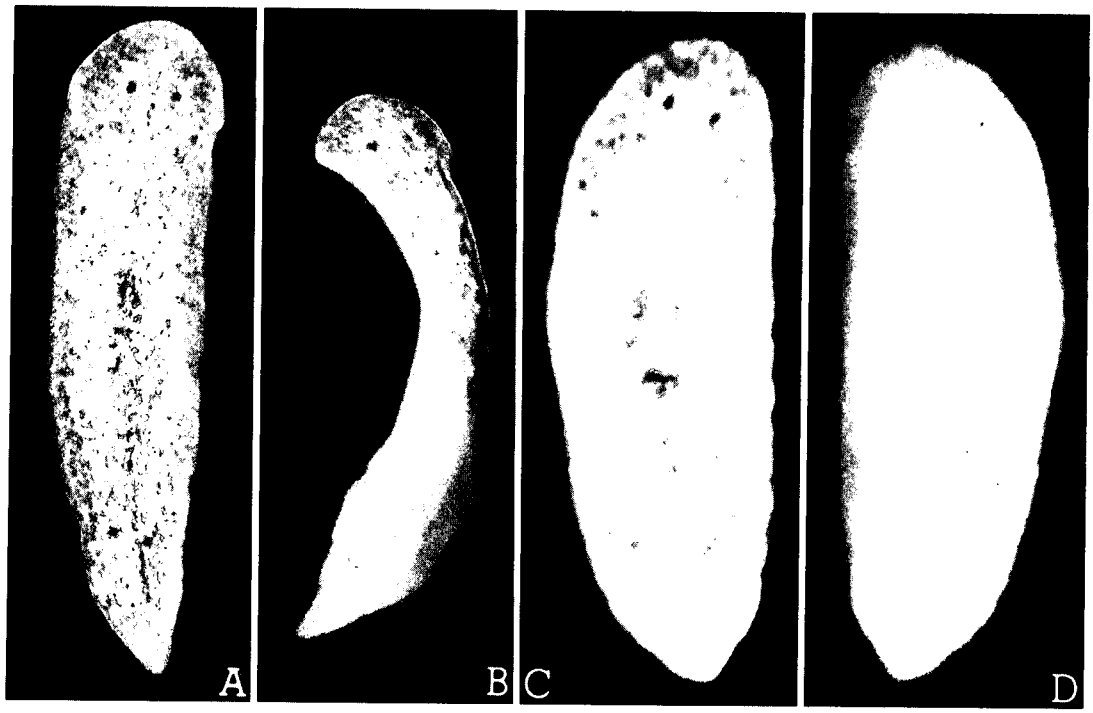

Fig. 10. *Dugesia* sp. (species of Taiwan) from the ponds of the Taipei Botanical Garden in Taipei (Specimen Lot No. 1458 group). All the same specimen. A and B: Photographs of live specimen. C and D: Photographs of preserved specimen. D, ventral view of the specimen C.

Cytological observation. The animals from the 3 localities (Taipei Botanical Garden, Neiwho Pond in Taipei and Wuku Luchou swamp in Taipei-hsien County) were examined cytologically (cf. Table 2). Their karyotypes were reported in preliminary forms by TAMURA, YAMAYOSHI, OKI, LUE & KAWAKATSU (1978) and TAMURA, YAMAYOSHI, OKI & KAWAKATSU (1979).

No. 4. Specimens from the Taipei Botanical Garden. Five asexual specimens were examined. Two hundred and forty-three mitoses revealed a chromosome number of 2x = 16 (Figs. 11 A and 12-4). The karyotype consists of 7 pairs of meta- or submetacentric chromosomes in descending order of size and one pair of large subtelocentric chromosomes. This karyotype is quite different from that of *Dugesia japonica* (*D. j. japonica*: n = 8, 2x = 16, 3x = 24; *D. j. ryukyuensis*: n = 7, 2x = 14, 3x = 21). It is however rather similar to the karyotypes of two *Dugesia* species from Thailand and South India (cf. TAMURA, YAMAYOSHI, OKI & KAWAKATSU, 1977).[4)]

Fig. 11. Photomicrographs of the chromosomes of *Dugesia* sp. (species of Taiwan) from 3 localities in Taiwan and *Dugesia* sp. (species of Madurai) in South India. A: Taipei Botanical Garden stock. 2x = 16. B: Neiwho Pond stock in Taipei. 2x = 16. C: Wuku Luchou swamp stock in Taipei-hsien County. 2x = 16. D: *Dugesia* sp. (species of Madurai). 2x = 16.

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4). The original descriptions of these two Southeast Asiatic *Dugesia* species including karyological descriptions will be published in March, 1980 (KAWAKATSU, TAMURA, YAMAYOSHI & OKI, In press).

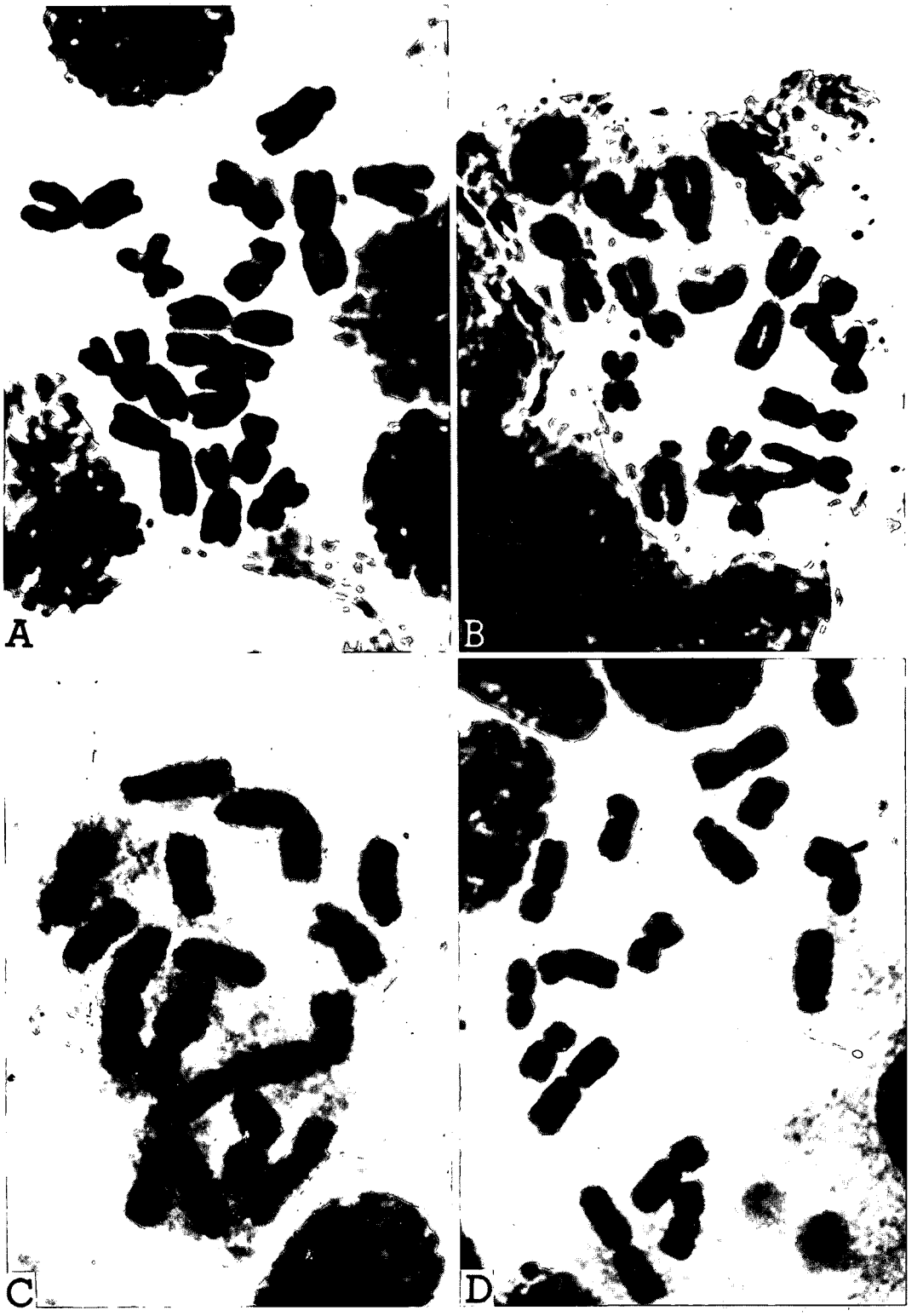

Fig. 11. Explanation on page 80.

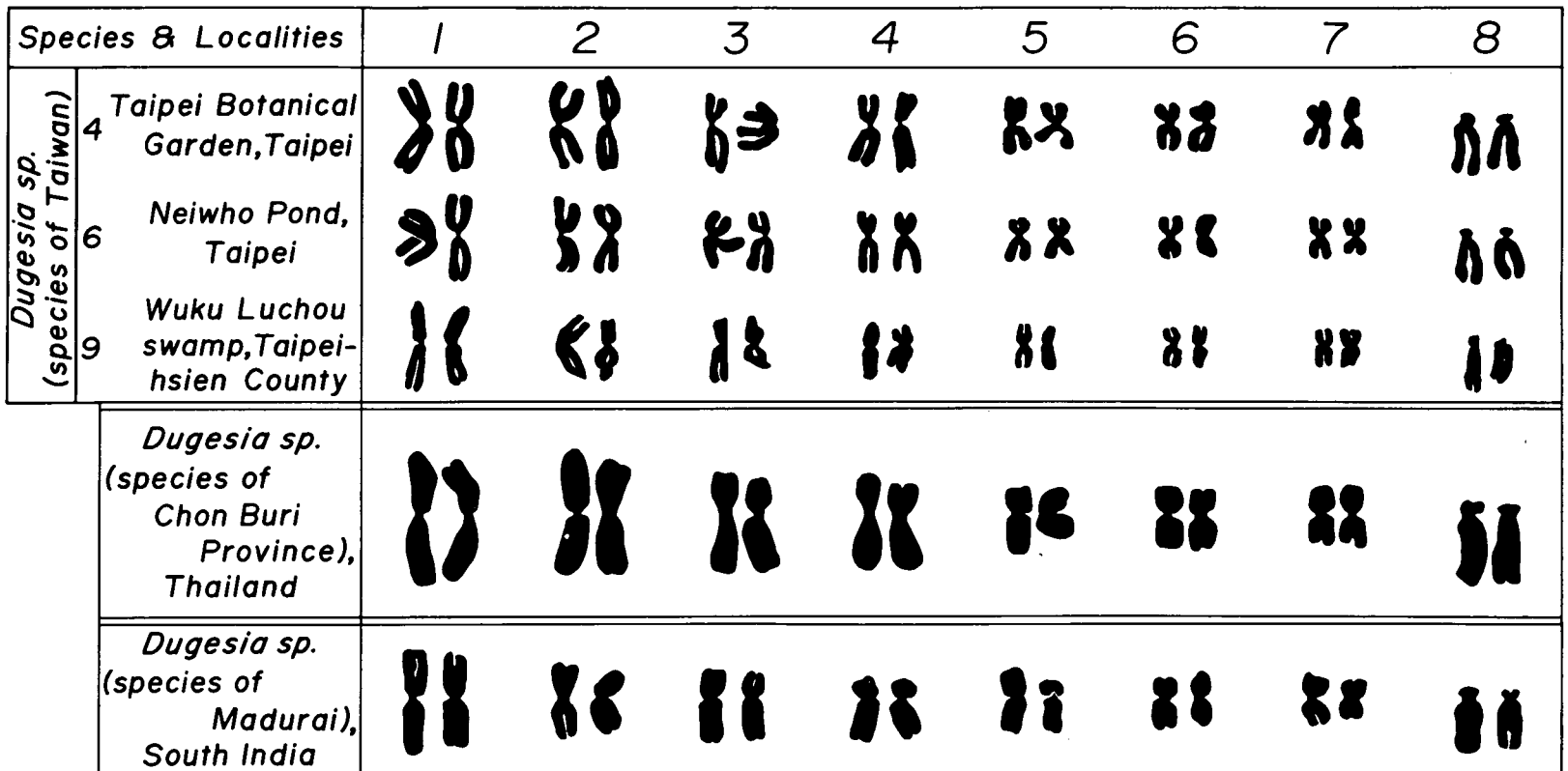

Fig. 12. Idiograms of *Dugesia* sp. (species of Taiwan) from 3 localities in Taiwan. 4: Taipei Botanical Garden stock. 2x = 16. 6: Neiwho Pond stock in Taipei. 2x = 16. 9: Wuku Luchou swamp stock in Taipei-hsien County. 2x = 16. Idiograms of *Dugesia* sp. (species of Chon Buri Province) in Thailand and *Dugesia* sp. (species of Madurai) in South India are also shown.

No. 6. Specimens from Neiwho Pond in Taipei. Five asexual specimens were examined. The karyotype was the same as that of the specimens from the Taipei Botanical Garden (Figs. 11 B and 12-6).

No. 9. Specimens from Wuku Luchou swamp in Taipei-hsien County. Seven asexual specimens were examined. No difference of the karyotype was examined between the animals from this locality and those from the foregoing 2 populations (Figs. 11 C and 12-9).

TAXONOMIC AND KARYOLOGICAL REMARKS

The taxonomic and zoogeographical considerations about *Dugesia japonica japonica* and *Dugesia japonica ryukyuensis* were discussed in detail in the previous paper (cf. KAWAKATSU, OKI, TAMURA & SUGINO, 1976). A slight degree of local variations of the external appearance and the genital anatomy in each of these two subspecies from Taiwan was observed. Especially, *D. j. ryukyuensis* from the Mt. Alishan district has a dark coloration; the dorsal lip of the valve surrounding the basal part of the penis papilla is smaller than the ventral one. The specimens of *D. j. ryukyuensis* from the Ryûkyû Islands and Middle China (Hangchow) have usually a pale coloration and the dorsal lip of the valve of the penis papilla is larger than the ventral one. The vagina is more developed in the specimens from Taiwan than that from the other areas.

It became very clear that *D. j. japonica* in Japan and Korea is a polymorphic species karyologically (cf. HIROSE, KATÔ & SUGINO, 1974; KAWAKATU & OKI, 1977; KAWAKATSU, OKI, TAMURA & SUGINO, 1976 a, b; KAWAKATSU, OKI, TAMURA & YAMAYOSHI, 1977; OKI & TAMURA, 1974, 1975 a, b; OKI, TAMURA, KAWAKATSU & SUGINO, 1976; SUGINO, HIROSE & KATÔ, 1973; TAMURA, YAMAYOSHI, OKI & KAWAKATSU, 1978, 1979 a, b; TAMURA, YAMAYOSHI, OKI, MURAYAMA & KAWAKATSU, 1978 a, b). The specimens having cells with chromosomes of the diploid, triploid, heteroploid and mixoploid forms were reported from various localities by these authors (for the latest knowledge, see an abstract and a table 2 of the paper by TAMURA, YAMAYOSHI, OKI & KAWAKATSU, 1979 a).

In the present report, we have found the animals of Taiwan having cells with chromosomes of 4 different types. These are as follows:

1) The diploid specimens ($2x = 16$) occurred in the samples from 3 localities (Matsu-tao Island stock, National Palace Museum stock and Teinmoo stock. 2) The heteroploid specimens having cells with chromosome number of 24 $[(3x-1)+1LB=24]$[5] occurred in the samples of the Chunghsing-hsintsun stock. 3) The heteroploid specimens having cells with chromosome number of 25 $[(3x-1)+2LB=25]$ occurred in the samples of the Uulei stock and the Tsouho stock (there may be some minute differences of the karyotype between them). 4) The mixoploid specimen having both cells with chromosome numbers of 24 and 25 in one body $[(3x-1)+1LB=24$ & $(3x-1)+2LB=25]$ occurred in the sample of the Tsouho stock. Up to the present, the last mixoploid karyotype is only recorded in Taiwan.

Dugesia sp. (species of Taiwan) from the Taipei district only occurred in ponds and swamps. Its karyotype is very similar to that of some Southeast Asiatic species, such as *Dugesia* species from Thailand and South India (Fig. 11 D; Fig. 12). It is highly probable that *Dugesia* sp. (species of Taiwan) may be an introduced species that has been brought to Taiwan waters with some aquatic plants from other countries.

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5). This karyotype is only recorded in Taiwan.

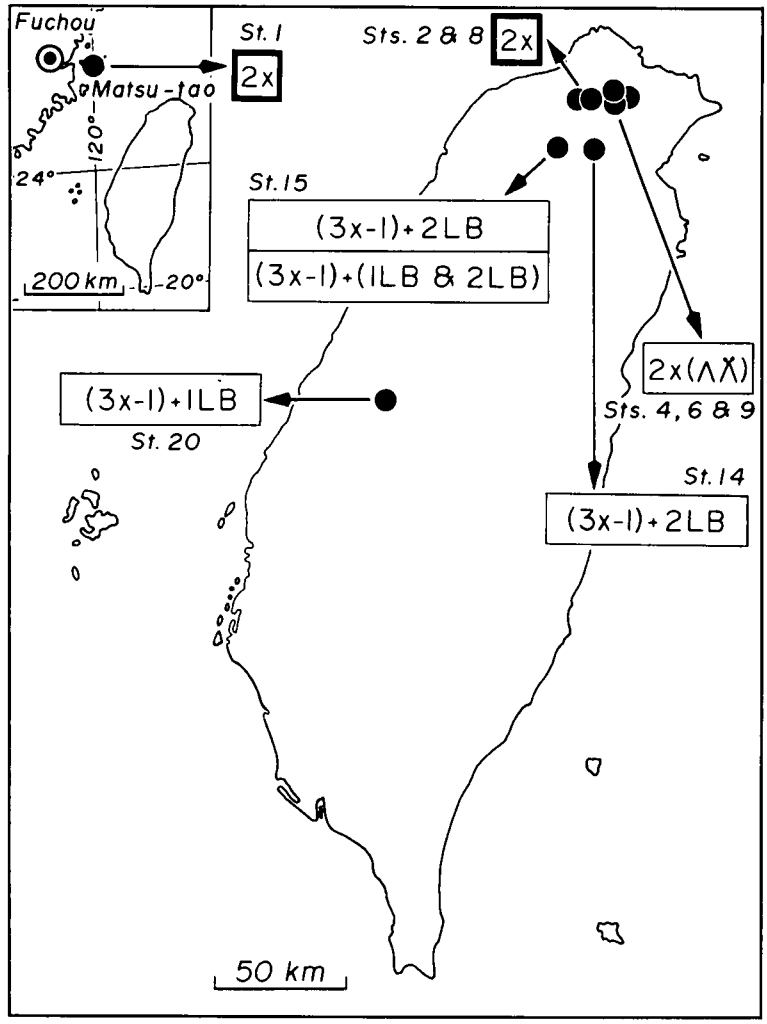

Fig. 13. Sketch map of Taiwan, showing the geographical distribution of the karyotypes of *Dugesia japonica japonica* KAWAKATSU from 6 localities (Sts. 1, 2, 8, 14, 15 and 20). The geographical distribution of the karyotype of *Dugesia* sp. (species of Taiwan) from 3 localities (Sts. 4, 6 and 9) is also shown. The rectangle areas surrounded by a heavy solid line indicate the karyotype of the animals having the copulatory apparatus.

ECOLOGICAL NOTE

Photographs of 3 typical localities of *Dugesia japonica japonica* in Taiwan are shown in Figure 14 (A-D). The data of the physico-chemical analysis of water of the National Palace Museum locality is shown in Table 3. Sexually mature specimens are very few in this locality.

Dugesia sp. (species of Taiwan) is the only planarian inhabiting in the ponds and swamps of Taiwan (Fig. 14 E-H). There are 3 ponds connected by a waterway in the Taipei Botanical Garden. Neiwho Pond consists of 2 ponds (the deepest point, ca. 2 m) and muddy. Wuku Luchou

Fig. 14. A-D. Photographs showing the localities of *Dugesia japonica japonica* from Taiwan. A : St. 11, Shochu-ken near Hsinden, Taipei-hsien County (臺北縣新店近郊小粗坑) ; B : St. 12, Chihtan-tsun Village near Hsintien, Taipei-hsien County (臺北縣新店近郊直潭村) ; C and D : St. 13, Uulei, Taipei-hsien County (臺北縣烏來).

Fig. 14. E-H (on pages 86 and 87). Photographs showing the localities of *Dugesia* sp. (species of Taiwan). E and F : St. 4, Ponds of the Taipei Botanical Garden, Taipei (臺北市臺北植物園); G : St. 6, Neiwho Pond on suburban Taipei (臺北市近郊內湖); H : St. 9, Wuku Luchou swamp, Taipei-hsien County (臺北縣五股蘆洲).

swamp was formed about 15 years ago. The ecological condition of these 3 localities are very similar and the main aquatic plant growing alongside of the shore is a water hyacinth (*Eichhornia crassipes*)

According to the data of the physico-chemical analysis, the percentage of nitrate content (ammonia-N and nitrate-N) of the water in these 3 localities of *Dugesia* sp. (Table 3) attains sometimes to a very high degree. The content of phosphate is also very high. But the dissolved oxygen is rather normal. This organic pollution of water is mainly due to the sewage from residential or industrial area and the excrements of water birds. In the Wuku Luchou swamp area, about 90 species of birds were found, among which cattle egret (*Bubulcus ibis coromandus*), little egret (*Egretta garzetta garzetta*) and night-heron (*Nycticorax nycticorax nycticorax*) are the dominat ones. Besides, there are several duck farms around the swamp.

It is supposed that the principal cause of the absence of sexually mature specimens of *Dugesia* sp. in ponds and swamps in the Taipei area is to be sought in the high temperature of the habitats.

Table 3. Results of physico-chemical analysis of waters from 4 localities of planarians in Taiwan.

Name of the stocks (localities)	Date	Temperature		pH	Hardness	Dissolved oxygen	Dissolved carbone dioxide	Phosphate	Nitrate nitrogen	Ammonia nitrogen
		Air temp. (℃)	Water temp. (℃)		(mg/l)	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(mg/l)
No. 2 National Palace Museum in Taipei	Jan. 4, 1978	14.0	16.0	5.6	75	7.0	36	1.6	7.0	1.3
	Feb. 18, 1978	10.5	12.5	6.5	80	8.0	28	2.1	5.5	0.2
No. 4 Taipei Botanical Garden	Mar. 14, 1978	22.0	15.0	6.5	65	7.0	48	0.3	8.1	0.3
No. 6 Neiwho Pond in Taipei	Mar. 23, 1978	?	32.0	6.5	110	7.0	32	0.6	10.5	0.4
	Apr. 18, 1978	22.0	21.0	7.2	80	10.0	88	0.2	20.0	0.1
No. 9 Wuku Luchou swamp in Taipei-hsien County	Sep. 15, 1978	35.0	?	7.9	60	?	24	0.5	2.5	0.2
	Oct. 22, 1978	22.0	21.0	8.7	85	8.0	12	1.3	2.5	2.4
	Nov. 4, 1978	19.0	21.0	8.5	130	8.5	8	1.1	3.5	2.4
	Nov. 19, 1978	20.0	17.5	8.5	95	8.1	8	0.2	2.5	0.5
	Dec. 17, 1978	21.0	17.0	8.5	80	9.0	?	0.6	0.3	2.8
	Jan. 19, 1979	14.5	15.5	8.0	85	8.0	32	1.0	3.8	6.3
	Feb. 24, 1979	24.0	19.0	7.8	121	8.0	28	1.6	3.5	7.3
	Mar. 27, 1979	16.0	14.0	7.3	70	7.0	32	0.1	0.6	4.2
	Apr. 22, 1979	25.0	21.0	7.3	70	8.5	20	1.6	3.0	6.6

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SUMMARY

The morphology and karyology of *Dugesia japonica* ICHIKAWA et KAWAKATSU, 1964, and *Dugesia* sp. (species of Taiwan) are described in the present paper. *D. j. japonica* ICHIKAWA et KAWAKATSU, 1964, is common in the entire region of Taiwan. The diploid form (2x = 16), the heteroploid forms and the mixoploid forms were found in the animals examined. *D. j. ryukyuensis* KAWAKATSU, 1976, is only found in the localities near the top of Mt. Alishan. No karyological data is available for this material. *Dugesia* sp. (species of Taiwan) occurred in ponds and swamps in the vicinity of Taipei. The non-sexual specimen has the diploid cells (2x = 16). Its karyotype is, however, different from that of *D. j. japonica*. On the contrary, it is very similar to that of two *Dugesia* species from Thailand and South India.

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中 文 摘 要

新增台灣淡水渦蟲之報告

川勝正治・沖 岩四郎・田村幸子・山吉孝雄・呂 光洋・萩谷盛雄

據川勝正治 1976 年以前的鑑定，台灣的渦蟲 *Dugesia japonica* ICHIKAWA et KAWAKATSU, 1964 有兩個亞種：*Dugesia japonica japonica* ICHIKAWA et KAWAKATSU, 1964 和 *Dugesia japonica ryukyuensis* KAWAKATSU, 1976, 最近由台灣的呂光洋和日本的今村泰二博士及萩谷盛雄等所收集到的四十多個地區的標本，經川勝正治組織學上及沖 岩四郎等細胞核染色體的鑑定，台灣地區的渦蟲多增加了一種 —— *Dugesia* sp.。

有關台灣地區兩種渦蟲的分佈情形如下：*Dugesia japonica japonica* 分布於馬祖南竿；台北台灣國立大學；台北故宮博物院；台北天母；台北銀河洞；新店小粗坑；新店直潭村；台北烏來；三峽湊合；北橫明池；新竹市；新竹關西；台中綠川；台中谷關；南投霧社本部溪；南投中興新村；南投南山溪；南投南山溪夢谷；南投南山溪關子嶺；南投廬山；花蓮港翠峯；嘉義交力坪；嘉義阿里山；屏東南仁山；屏東墾丁公園；台北淡水；南投溪頭；高雄扇平；(馬祖大坪；台北雙溪瀑布；台北石碇；台北烏來；北橫明池；台中武陵農場；南投南山溪；花蓮港天祥長春祠；花蓮港北落溪紅葉村；嘉義阿里山；南投信義；高雄扇平；屏東四重溪溫泉等地所得標本，都屬無性個體，經鑑定後，似乎亦都屬於 *Dugesia japonica japonica*)。*Dugesia japonica ryukyuensis* 分布於嘉義阿里山。由以前和目前的資料判斷，*Dugesia japonica ryukyuensis* 似乎僅分布於，台灣的山區而已。至於未經命名的 *Dugesia* sp. 則分布在台北市植物園,台北內湖及台北五股蘆洲沼澤區，這三個地區有幾個共同特性，即水邊有很多水生植物，水中氮，磷化合物的含量高，溫度也較高，而且普遍受到有機物的汚染。

至於台灣渦蟲細胞核染色體可歸類爲四型：(1) 雙倍體型：2x = 16，屬於馬祖，故宮博物院和天母的族群。(2) 異三倍體型：24 [(3x − 1) + 1LB = 24]，屬於中興新村的族群。(3) 異三倍體型：25 [(3x − 1) + 2LB = 25]，屬於烏來和三峽湊合族群。(4) 混合三倍體型：24 [(3x − 1) + 1LB = 24] 和 25 [(3x − 1) + 2LB = 25]，屬於三峽湊合的族群，此種在一個個體上有兩種細胞核染色體型的，目前僅在台灣發現。

Dugesia sp. 的細胞核染色體爲雙倍體型 (2x = 16)，但其細胞核型與 *Dugesia japonica japonica* 不一樣，相反的，*Dugesia* sp. 的核型與在泰國和東南亞的渦蟲很類似。

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NOTE ADDED IN PROOF:

While this paper was in the press, a paper by UMYLINA (1979) has recently come to our attention.

UMYLINA, T. M., 1979. K voprosu ob ispol'zovanii kariologicheskogo metoda v systematike êndemichnykh planarii Baikala (Tricladida, Paludicola). Kariosistematika Bespozvonochnykh Zhivotnykh, Akademiia Nauk SSSR, Zool. Inst., Leningrad, pp. 111-114.

She listed in the table on page 113 that the chromosome number of *Dugesia japonica* is $n = 8$ and $n = 8-12$ based upon the data of papers by SUGINO, HIROSE & KATO (1973; she cited as Sugino, Hirose, 1973) and OKI & TAMURA (1975; she cited as Iwashiro, Sachiko, 1975).

There may be some confusions in her understanding about the chromosome number of *D. japonica*. It was only demonstrated in those Japanese papers that the animals of *D. japonica* from several localities in the vicinities of Kyôto and Ôsaka have two types of cells intermingled in one body, i.e., one of them with the chromosome number of 16 and the other with that of 24. It became clear in the further chromosomal analysis of *D. japonica japonica* that the animals having both diploid ($2x = 16$) and triploid ($3x = 24$) sets of chromosomes in one body occurred from various localities in Japan and Korea (cf. KAWAKATSU, OKI, TAMURA & SUGINO, 1976; and others). The chromosome number of *D. japonica ryukyuensis* is $n = 7$ (haploid), $2x = 14$ (diploid) and $3x = 21$(triploid). The variation of the karyotypes (heteroploidy and mixoploidy) of *D. japonica* was also observed in the animals from many localities (cf. TAMURA, YAMAYOSHI, OKI, MURAYAMA & KAWAKATSU, 1978; TAMURA, YAMAYOSHI, OKI & KAWAKATSU, 1979). As far as our observation goes, there is no population of the animals of *D. japonica* that have the haploid chromosome of $n = 9$, $n = 10$, $n = 11$, or $n = 12$.

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